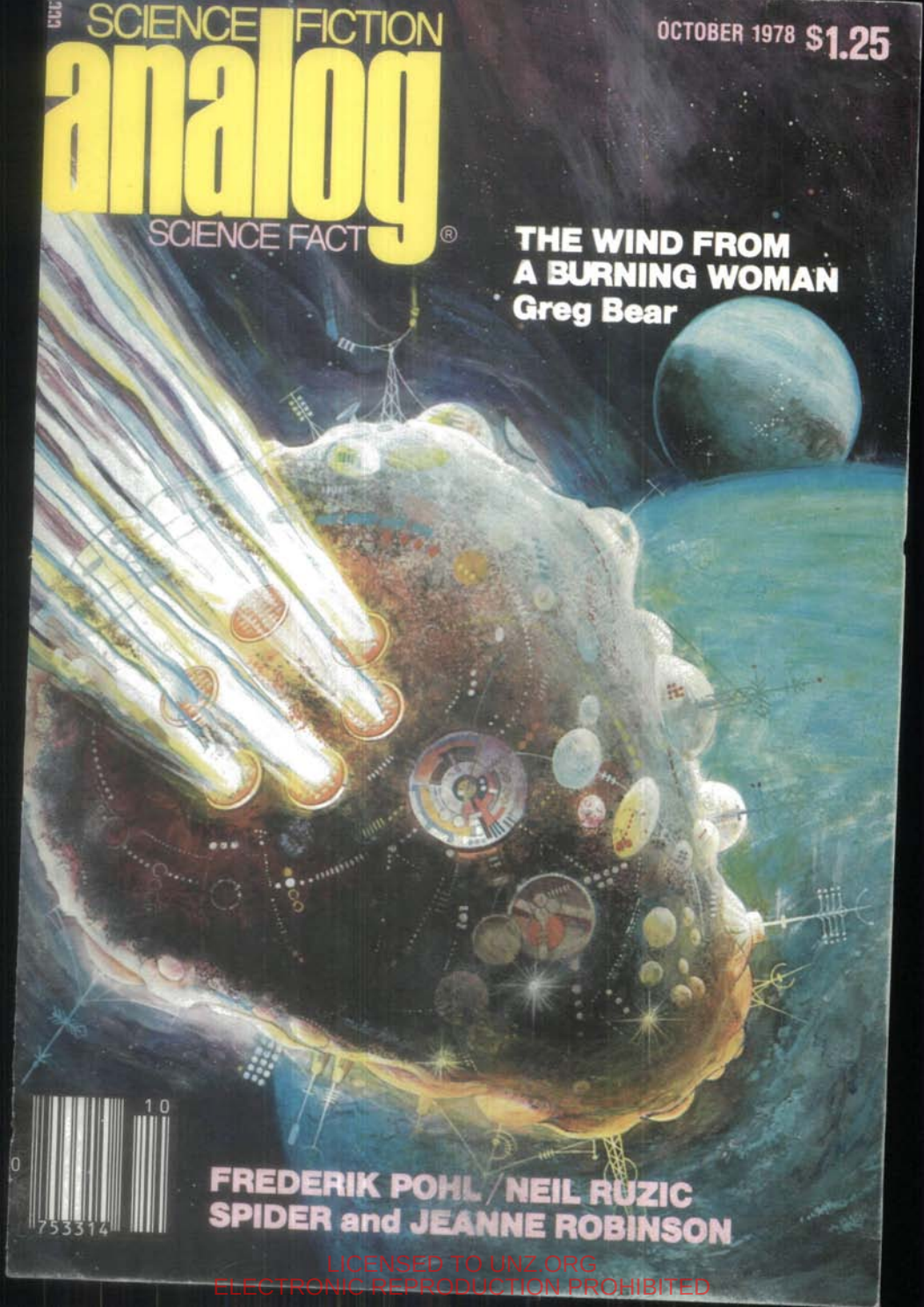

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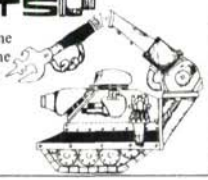

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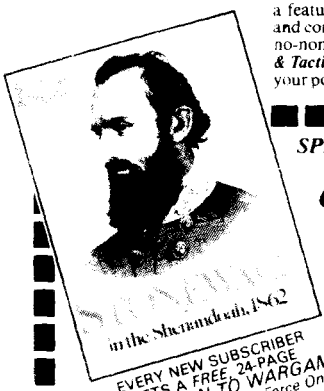
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editorial

...mics has often been called "the ...al science." Yet economic theo... are often trying to do almost ...what science fiction writers ... present glimpses of potential fu... to give us an idea of what tomorrow might be like if certain assumptions are granted.

Sometimes these views of the future are in the nature of tantalizing promises. Sometimes they are somber warnings.

Two books recently published offer a promise and warning. Either book could turn out to be prophetic, depending on our own economic behavior over the next decade or so. The books' speculations about the future seem to be mutually exclusive, however.

Walt W. Rostow, former advisor to Presidents Kennedy and Johnson, and now professor of economics and history at the University of Texas, has written *The World Economy: History and Prospects* (University of Texas Press, $34.50 [!]).

Lester R. Brown, president of Worldwatch Institute, a research organization based in Washington, D.C., is the author of *The Twenty-ninth Day: Accommodating Human Needs and Numbers to the Earth's Resources* (W. W. Norton & Co. $3.95 in paperback).

Rostow sees world economic cycles swinging up and down in fifty-year-long periods, an idea first broached in the 1920s by the Russian economist Kondratieff—who died in a Soviet

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prison camp, possibly for linking Communist economic trends with those of the despised capitalist nations.

According to Rostow, we are now in the fifth price upswing in America's 200-year history; price upswings are those times when prices for goods and services are high. Other upswing periods were in the 1790s, 1850s, 1890s and the latter part of the 1930s, as Europe and America prepared for World War II.

Upswings in the fifty-year-long Kondratieff cycle are marked by price inflation, high interest rates, and a relatively beneficial position for the producers of raw materials—which includes farmers. On downswings, farmers and other raw materials producers suffer relative losses, as their prices deflate while the real wages of workers go up.

What of today?

Since about 1972 (or approximately the beginnings of OPEC) a new stage in world economic development has begun, Rostow believes. One key factor is population pressure: as world population grows, the demand on food and other resources forces prices upward. Even clean air and water are becoming expensive, all around the world.

We tend to see this as a "crisis," and studies such as the Club of Rome's *Limits to Growth* and its follow-up reports foster the impression that we are approaching a very crucial phase of history: a worldwide cataclysm may be just around the corner.

That may be true, but it's not inevitable.

Our current high-price, high-inflation, resource-tight "crisis" is another upswing of the Kondratieff cycle. Most of us grew up in the decades of the 1950s and 60s, and have been heavily influenced by that economic Golden Age. It was a boom period, perhaps the greatest worldwide economic boom in history. Employment was high, and prices for raw materials were low. During the 1951-72 era, in the United States the price of electricity actually fell forty-three percent relative to the general price level. The price for gasoline fell fifteen to twenty percent relative to the prices of food and other raw materials.

But that era is past. On the Kondratieff upswing, prices get higher. Rostow sees that not so much as a problem, but as an opportunity.

"We are going to need a substantial increase in private and public research and development," he said in an interview in the *New York Times*.

In short, Rostow believes that one way to bring economic well-being out of the current situation is to invest significantly in R&D.

Since the Great Depression of the 1930s, it has been the common wisdom of economists and politicians to pour money into the economy to stimulate consumer demand for goods and services. This is what has been called Keynesian Economics, although it's not quite what Keynes had in mind. It's also called "pump priming": the government spreads money around,

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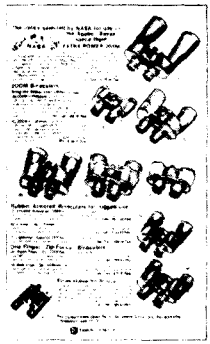

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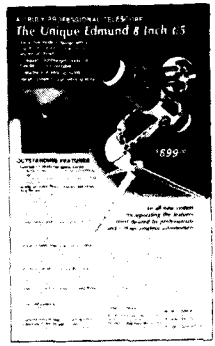

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people use the newfound cash to buy things, and the economy revives and prospers.

It worked in the Great Depression—although probably Adolf Hitler should get more credit for *that* economic recovery than Lord Keynes. But the same "pump priming" isn't working very well today.

Rostow believes that government—and corporate!—investment must be made in selective areas of *production*, not consumption. "As I look at the investment requirements of the United States," he told the *Times*, "it will take a great lack of skill and wisdom to produce chronic unemployment."

Where must we invest our money and efforts to achieve full employment? In research and development related to energy, pollution, transportation, and water-soil erosion.

Rostow sounds like so many of the earnest readers of Analog who have pleaded with their Congressional representatives for greater R&D efforts!

And unlike the conclusion reached in *Limits to Growth*, Rostow believes that without economic growth we face social stagnation, inflation, heavy unemployment and—ultimately—a crumbling of our strategic power vis-a-vis the Russians and Chinese.

His message almost sounds like the standard answer of the typical science fiction enthusiast: invest heavily in R&D, particularly in energy, pollution control, and transportation. Not only are these efforts enormously productive and useful in themselves, but their economic consequences will produce a healthier economy for the whole nation. And, ultimately, for the whole world.

That's the promise. If by "transportation" Rostow means the space program should be included, he will probably win the vote of every science fiction reader in America for any office he cares to run for.

Now to get the politicians and corporate managers to heed his advice!

The warning from Brown and his Worldwatch Institute must receive equal attention from all of us, even though it is a far less palatable message. Again, it is something that will come as scant surprise to the readers of this magazine.

Brown states simply that our economic well-being—and our very lives—depend on this planet's biological resources. In particular the human race is almost totally dependent on four worldwide biological "systems": fisheries, forests, grasslands and croplands. All our food and almost all our raw materials (except for minerals and petroleum products) come from these four biological systems.

The great thing about biological systems is that they are renewable. They renew themselves, in fact.

But only if we don't destroy them.

Brown's point is that we are harvesting the world's fisheries, forests, grasslands, and croplands faster than they can replenish themselves. And when biological resources are harvested faster than they can replenish themselves, "fisheries collapse, forests disappear, grasslands are converted

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into barren wastelands, and croplands deteriorate."

Brown continues, "The condition of the (world's) economy and of these biological systems cannot be separated." But economists don't think in terms of biological systems. And because they don't, they advocate policies that are pushing us toward ecological disaster. To say nothing of economic ruin.

Again, the rapid growth of human population is the root cause of the problem. And we are pushing these four basic biological systems to their limits *simultaneously*. It's not a case of one, or even two of them, being in trouble. They all are. And so are we.

Brown sees the solution to this crucial problem in some form of social control that will force people to consume less, to adopt simpler lifestyles, to limit their population growth. Conservation and population planning are the only ways to save our vital biological systems, he believes.

But that would require a worldwide dictatorship of staggering severity.

Which will we have? Rostow's economic growth spearheaded by renewed vigor in R&D? Or Brown's worldwide conservation and population control? Could we have both? Or neither?

Classic science fiction scenarios. Maybe the place to test these ideas is right here.

THE EDITOR

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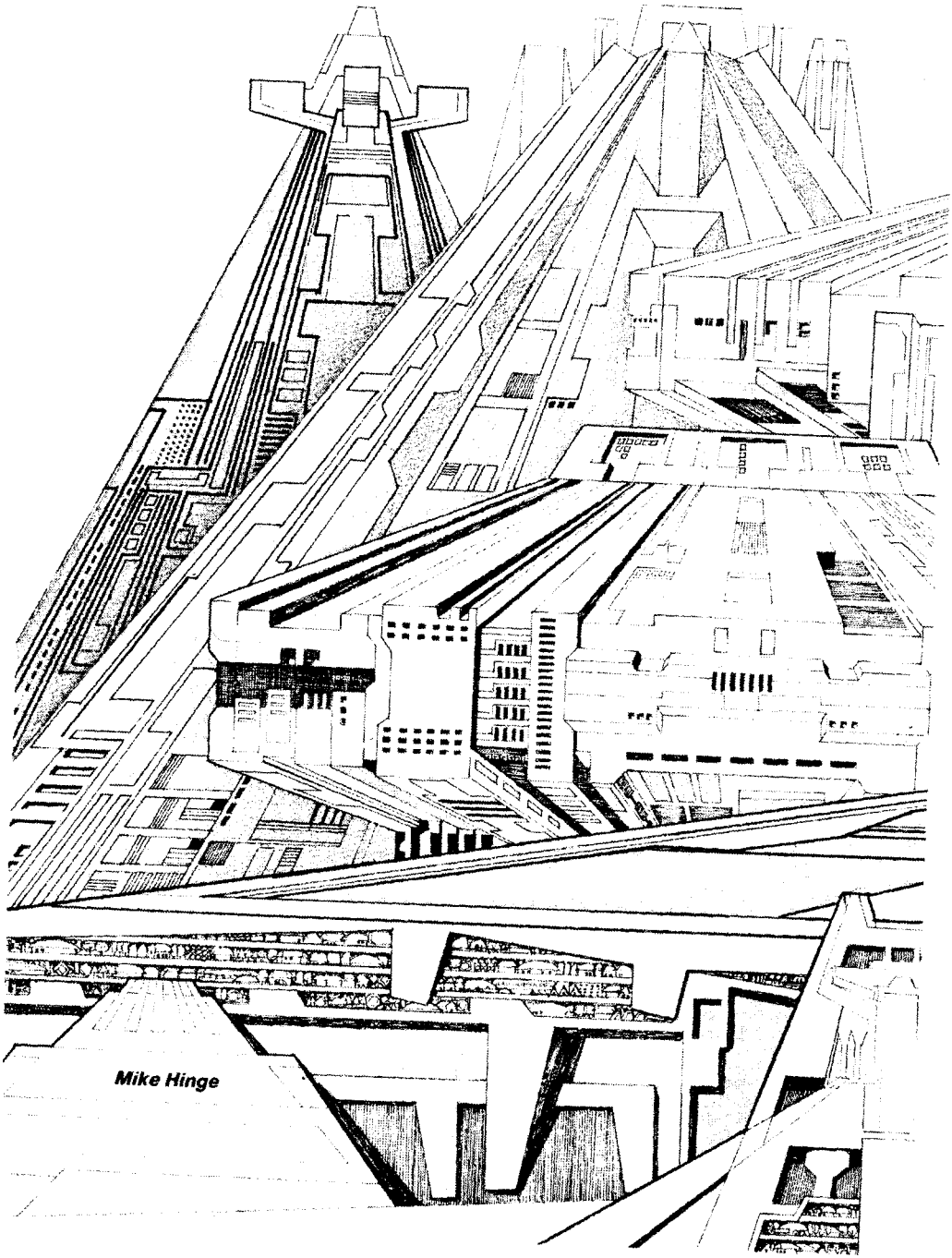

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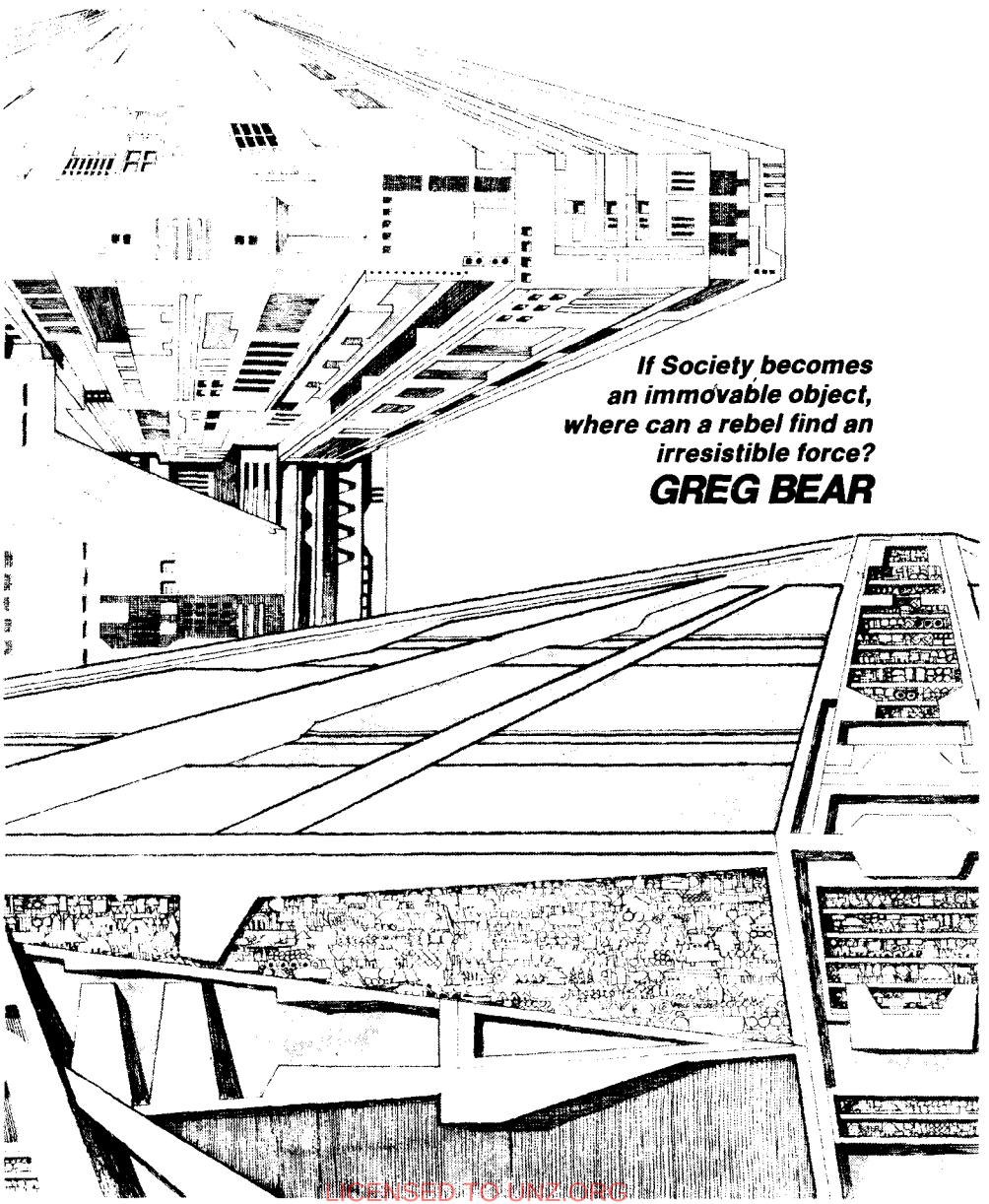
the wind from a burning woman



If Society becomes an immovable object, where can a rebel find an irresistible force?

GREG BEAR

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Five years later, the glass bubbles were intact, the wires and pipes were taut, and the city—strung across Psyche's surface like a dewy spider's web wrapped around a thrown rock—was still breathtaking. It was also empty. Hexamon investigators had swept out the final dried husks and bones. The asteroid was clean again. The plague was over.

Giani Turco turned her eyes away from the port and looked at the displays. Satisfied by the approach, she ordered a meal and put her work schedule through the processor for tightening and trimming. She had six tanks of air, enough to last her three days. There was no time to spare. The robot guards in orbit around Psyche hadn't been operating for at least a year and wouldn't offer any resistance, but four small pursuit bugs had been planted in the bubbles. They turned themselves off whenever possible, but her presence would activate them. Time spent in avoiding and finally destroying them: one hour forty minutes, the processor said. The final schedule was projected in front of her by a pen hooked around her ear. She happened to be staring at Psyche when the readout began; the effect—red numerals and letters over gray rock and black space—was pleasingly graphic, like a film in training.

Title by permission of Michael Bishop, from his poem "Postcards to Athena"

Turco had dropped out of training six weeks early. She had no need for a final certificate, approval from the Hexamon, or any other nicety. Her craft was stolen from Earth orbit, her papers and cards forged, and her intentions entirely opposed to those of the sixteen Corporeal Desks. On Earth, some hours hence, she would be hated and reviled.

The impulse to sneer was strong in her—pure theatrics, since she was alone—but she didn't allow it to break her concentration. (Worse than sheep, the seekers after security, the cowardly citizens who tacitly supported the forces that had driven her father to suicide and murdered her grandfather; the seekers after security who lived by technology, but believed in the just influences: Star, Logos, Fate and Pneuma. . .)

To calm her nerves, she sang a short song while she selected her landing site.

The ship, a small orbital tug, touched the asteroid like a mote settling on a boulder and made itself fast. She stuck her arms and legs into the suit receptacles and the limb covers automatically hooked themselves to the thorax. The cabin was too cramped to get into a suit any other way. She reached up and brought down the helmet, pushed until all the semifluid seals seized and beeped, and began the evacuation of the cabin's atmosphere.

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Then the cabin parted down the middle and she floated slowly, fell more slowly still, to Psyche's surface.

She turned once to watch the cabin clamp together, and to see if the propulsion pods behind the tanks had been damaged by the unusually long journey. They'd held up well.

She took hold of a guide wire after a flight of twenty or twenty-five meters and pulled for the nearest glass bubble. Five years before, the milky spheres had been filled with the families of workers setting the charges which would form Psyche's seven internal chambers. Holes had been bored from the Vlasseg and Janacki poles, on the narrow ends of the huge rock, through the center. After the formation of the chambers, materials necessary for atmosphere would have been pumped into Psyche through the bore holes, while motors increased her natural spin to create artificial gravity inside.

Twenty years, Psyche would have been green and beautiful, filled with hope and passengers. But now ignorance was Queen, fear King, and propaganda the jester.

The control bubble hatches had been sealed by the last of the investigators. Since Psyche was not easily accessible, even in its lunar orbit, the seals hadn't been applied thoroughly. But it took her an hour to break in. The glass ball towered above her, a hundred feet in diameter, translucent walls mottled by the shadows of rooms and equipment. Psyche rotated once every three hours, and light from the sun was beginning to flush the top of the bubbles in the local cluster. Moonlight illuminated the shadows. She pushed the cement shreds away, watching them float lazily to the pocked ground. Then she checked the airlock to see if it were still functioning. She wanted to keep the atmosphere inside the bubble, to check it for psychotropic chemicals; she would not leave her suit at any rate.

The lock door opened with a few jerks and closed behind her. She brushed crystals of frost off her faceplate and the inner lock door's port. Then she pushed the button for the inner door, but nothing happened. The external doors were on a different power supply, which was no longer functioning—or, she hoped, had only been turned off.

From her backpack she removed a half-meter pry bar. The break-in took another fifteen minutes. She was now five minutes ahead of schedule.

Across the valley, the fusion power plants which supplied power to the Geshel populations of Tijuana and Chula Vista sat like squat mountains of concrete. By Naderite law, all nuclear facilities were surrounded by multiple domes and pyramids, wheth-

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er they posed any danger or not. The symbolism was two-fold—it showed the distaste of the ruling Naderites for energy sources which were not nature-kinetic, and it carried on the separation of Naderites-Geshels. Farmer Kollert, advisor to the North American Hexamon and Ecumentalist to the California Corporeal Desk, watched the Sun set behind the false peak and wondered vaguely if there was any symbolism in the act. Was not fusion the source of power for the Sun? He smiled. Such things seldom occurred to him; perhaps it would amuse a Geshel technician.

His team of five Geshel scientists would tour the plants two days from now and make their report to him. He would then pass on *his* report to the Desk, acting as interface for the invariably clumsy, elitist language the Geshel scientists used. In this way, through the medium of advisors across the globe, the Naderites oversaw the production of Geshel power. By their grants and control of capital, his people had once plucked the world from technological overkill, and the battle was on-going still—a war against some of mankind's darker tendencies.

He finished his evening juice and took a package of writing utensils from the drawer in the veranda desk. The reports from last month's energy consumption balancing needed to be edited and revised, based on new estimates—and he enjoyed doing the work himself, rather than giving it to the literary computer personna. It relaxed him to do things by hand. He wrote on a positive feedback slate, his scrawly letters adjusting automatically into script, with his tongue between his lips and a pleased frown creasing his brow.

"Excuse me, Farmer." His ur-wife, Gestina, stood in the French doors leading to the veranda. She was as slender as when he'd married her, despite fifteen years and two children.

"Yes, *cara*, what is it?" He withdrew his tongue and told the slate to store what he'd written.

"Josef Krupkin."

Kollert stood up quickly, knocking the metal chair over. He hurried past his wife into the dining room, dropped his bulk into a chair and drew up the crystalline cube on the alabaster table top. The cube adjusted its picture to meet the angle of his eyes and Krupkin appeared.

"Josef! This is unexpected."

"Very," Krupkin said. He was a small man with narrow eyes and very curly black hair. Compared to Kollert's bulk, he was dapper—but thirty years behind a desk had given him the usual physique of a Hexamon sideroomer. "Have you ever heard of Giani Turco?"

Kollert thought for a moment. "No, I haven't. Wait—Turco. Related to Kimon Turco?"

"Daughter. California should keep better track of its radical Geshels, shouldn't it?"

"Kimon Turco lived on the Moon."

"But she lived in your district."

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"Yes, fine. What about her?" Kollert was beginning to be perturbed. Krupkin enjoyed roundabouts even in important situations—and for him to call at this address, at such a time, meant something important had happened.

"She's calling for you. She'll only talk to you, none of the rest. She won't even accept President Praetori."

"Yes. Who is she? What has she done?"

"She's managed to start up Psyche. There was enough reaction mass left in the Beckmann motors to alter it into an Earth-intersect orbit." The left side of the cube was flashing bright red, indicating the call was being scrambled.

Kollert sat very still for a few seconds. There was no need acting incredulous. Krupkin was in no position to joke. But the enormity of what he said—and the impulse to disbelieve, despite the bearer of the news—froze Kollert for an unusually long time. He ran his hand through lank blond hair.

"Kollert," Krupkin said. "You look like you've been pole-axed."

"Is she telling the truth?"

Krupkin shook his head. "No, Kollert, you don't understand. She hasn't *claimed* these accomplishments. She hasn't said anything about them yet. She just wants to speak to you. But our tracking stations say there's no doubt. I've spoken with the officer who commanded the last inspection. He says there was enough mass left in the Beckmann drive positioning motors to push the asteroid—"

"This is incredible! No precautions were taken? The mass wasn't drained, or something?"

"I'm no Geshel, Farmer. My technicians tell me the mass was left on Psyche because it would have cost several hundred million—"

"That's behind us now. Let the journalists worry about that, if they ever hear of it." He looked up and saw Gestina still standing in the French doors. He held up his hand to tell her to stay where she was. She was going to have to keep to the house, incommunicado, for as long as it took to straighten this out.

"You're coming?"

"Which center?"

"Does it matter? She's not being discreet. Her message is hitting an entire hemisphere, and there are hundreds of listening stations to pick it up. Several aren't under our control. Once anyone pinpoints the source, the story is going to be clear. For your convenience, go to Baja Station. Mexico is signatory to all the necessary pacts."

"I'm leaving now," Kollert said. Krupkin nodded and the cube went blank.

"What was he talking about?" Gestina asked. "What's *Psyche*?"

"A chunk of rock, dear," he said. Her talents lay in other directions—she wasn't stupid. Even for a Naderite, however, she was unknowledgeable about things beyond the Earth.

He started to plan the rules for her movements, then thought better of it and said nothing. If Krupkin was

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right—and he would be—there was no need. The political consideration, if everything turned out right, would be enormous. He could run as Governor of the Desk, even President of the Hexamon. . .

And if everything didn't turn out right, it wouldn't matter where anybody was.

Turco sat in the middle of her grandfather's control center and cried. She was tired and sick at heart. Things were moving rapidly now, and she wondered just how sane she was. In a few hours, she would be the worst menace the Earth had ever known, and for what cause? Truth, justice? They had murdered her grandfather, discredited her father and driven him to suicide—but all seven billion of them, Geshels and Naderites alike?

She didn't know whether she was bluffing or not. Psyche's fall was still controllable, and she was bargaining it would never hit the Earth. Even if she lost and everything was hopeless, she might divert it, causing a few tidal disruptions, minor earthquakes perhaps, but still passing over four thousand kilometers from the Earth's surface. There was enough reaction mass in the positioning motors to allow a broad margin of safety.

Resting lightly on the table in front of her, its ends not clamped, was a chart which showed the basic plan of the asteroid. The positioning motors surrounded a crater at one end of the egg-shaped chunk of nickel-iron and rock. Catapults loaded with huge barrels of reaction mass had just a few hours earlier launched a salvo to rendezvous above the crater's center. Beckmann drive beams had then surrounded the mass with a halo of energy, releasing its atoms from the bonds of nature's weak force. The blast had bounced off the crater floor, directed by the geometric patterns of heat-resistant slag. At the opposite end, a smaller guidance engine was in position, but it was no longer functional and didn't figure in her plans. The two tunnels which reached from the poles to the center of Psyche opened into seven blast chambers, each containing a shaped fusion charge. She hadn't checked to see if the charges were still armed. There were so many things to do.

She sat with her head bowed, still suited up. Though the bubbles contained enough atmosphere to support her, she had no intention of unsuiting. In one gloved hand she clutched a small ampul with a nozzle for attachment to air and water systems piping. The Hexamon Nexus' trumped-up excuse of madness caused by near-weightless conditions was now a shattered, horrible lie. Turco didn't know why, but the Psyche project had been deliberately sabotaged, and the psy-

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chotropic drugs still lingered.

Her grandfather hadn't gone mad contemplating the stars. The asteroid crew hadn't mutinied out of misguided Geshel zeal and spacesickness.

Her anger rose again and the tears stopped. "You deserve whoever governs you," she said quietly. "Everyone is responsible for the actions of their leaders."

The computer display cross-haired the point of impact. It was ironic—the buildings of the Hexamon Nexus were

only sixty kilometers from the zero point. She had no control over such niceties, but nature and fate seemed to be as angry as she was.

"Moving an asteroid is like carving a diamond," the Geshel advisor said. Kollert nodded his head, not very interested. "The charges for initial orbit change—moving it out of the asteroid belt—have to be placed very carefully or the mass will break up and be useless. When the asteroid is close enough to the Earth-Moon system to meet the major crew vessels, the work has only begun. Positioning motors have to be built—"

"Madness," Kollert's secretary said not pausing from his monitoring of communications between associate committees.

"And charge tunnels drilled. All of this was completed on the asteroid ten years ago."

"Are the charges still in place?" Kollert asked.

"So far as I know," the Geshel said.

"Can they be set off now?"

"I don't know. Whoever oversaw dismantling should have disarmed to protect his crew—but then, the reaction mass should have been jettisoned, too. So who can say? The report hasn't cleared top secrecy yet."

And not likely to, either, Kollert thought. "If they haven't been disarmed, can they be set off now? What would happen if they were?"

"Each charge has a complex communications system. They were designed to be set off by coded signals and could probably be set off now, yes, if we had the codes. Of course, those are top-secret, too."

"What would happen?" Kollert was becoming impatient with the Geshel.

"I don't think the charges were ever given a final adjustment. It all depends on how well the initial alignment was performed. If they're out of true, or the final geological studies weren't taken into account, they could blow Psyche to pieces. If they are true, they'll do what they were intended to do—form chambers inside the rock. Each chamber would be about fifteen kilometers long, ten kilometers in diameter—"

"If the asteroid were blown apart, how would that affect our situation?"

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"Instead of having one mass hit, we'd have a cloud, with debris twenty to thirty kilometers across and smaller."

"Would that be any better?" Kollert asked.

"Sir?"

"Would it be better to be hit by such a cloud than one chunk?"

"I don't think so. The difference is pretty moot—either way, the surface of the Earth would be radically altered, and few life forms would survive."

Kollert turned to his secretary. "Tell them to put a transmission through to Giani Turco."

The communications were arranged. In the meantime, Kollert tried to make some sense out of the Geshel advisor's figures. He was very good at mathematics, but in the past sixty years many physics and chemistry symbols had diverged from those used in biology and psychology. To Kollert, the Geshel mathematics was irritatingly dense and obtuse.

He put the paper aside when Turco appeared on the cube in front of him. A few background beeps and noise were eliminated and her image cleared. "Ser Turco," he said.

"Ser Farmer Kollert," she replied several seconds later. A beep signaled end of one side's transmission. She sounded tired.

"You're doing a very foolish thing."

"I have a list of demands," she said.

Kollert laughed. "You sound like the Good Man himself, Ser Turco. The tactic of direct confrontation. Well, it didn't work all the time, even for him."

"I want the public—Geshels and Naderites both—to know why the Psyche project was sabotaged."

"It was not sabotaged," Kollert said calmly. "It was unfortunate proof that humans cannot live in conditions so far removed from the Earth."

"Ask those on the Moon!" Turco said bitterly.

"The Moon has a much stronger gravitational pull than Psyche. But I'm not briefed to discuss all the reasons why the Psyche project failed."

"I have found psychotropic drugs—traces of drugs and containers—in the air and water the crew breathed and drank. That's why I'm maintaining my suit integrity."

"No such traces were found by our investigating teams. But Ser Turco, neither of us is here to discuss something long past. Speak your demands—your price—and we'll begin negotiations." Kollert knew he was walking a loose rope. Several Hexamon terrorist team officers were listening to everything he said, waiting to splice in a timely splash of static. Conversely, there was no way to stop Turco's words from reaching open stations on the Earth. He was sweating heavily under his arms. Stations on the Moon—the bastards there would probably be sympathetic to her—could pick up his messages and relay them back to the Earth. A drop of

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perspiration trickled from armpit to sleeve and he shivered involuntarily.

"That's my only demand," Turco said. "No money, not even amnesty. I want nothing for myself. I simply want the people to know the truth."

"Ser Turco, you have an ideal platform to tell them all you want them to hear."

"The Hexamons control most major reception centers. Everything else—except for a few ham and radio-astronomy amateurs—is cabled and controlled. To reach the most people, the Hexamon Nexus will have to reveal its part in the matter."

Before speaking to her again, Kollert asked if there were any way she could be fooled into believing her requests were being carried out. The answer was ambiguous—a few hundred people were thinking it over.

"I've conferred with my staff, Ser Turco, and I can assure you, so far as the most privy of us can tell, nothing so villainous was ever done to the Psyche project." At a later time, his script suggested, he might indicate that some tests had been overlooked, and that a junior officer had suggested lunar sabotage on Psyche. That might shift the heat. But for the moment, any admission that drugs existed in the asteroid's human environments could backfire.

"I'm not arguing," she said. "There's no question that the Hexamon Nexus had somebody sabotage Psyche."

Kollert held his tongue between his lips and punched key words into his script processor. The desired statements formed over Turco's image. He looked at the camera earnestly. "If we had done anything so heinous, surely we would have protected ourselves against an eventuality like this—drained the reaction mass in the positioning motors—" One of the terrorist team officers was waving at him frantically and scowling. The screen's words showed red where they were being covered by static. There was to be no mention of how Turco had gained control of Psyche. The issue was too sensitive and blame hadn't been placed yet. Besides, there was still the option of informing the public that Turco had never gained control of Psyche at all. If everything worked out, the issue would have been solved without costly admissions.

"Excuse me," Turco said a few seconds later. The time lag between communications was wearing on her nerves, if Kollert was any judge. "Something was lost there."

"Ser Turco, your grandfather's death on Psyche was accidental, and your actions now are ridiculous. Destroying the Hexamon Nexus—" much better than saying "Earth"—"won't mean a thing." He leaned back in the seat, chewing on the edge of his index finger. The gesture had been approved an hour before the talks began, but it was nearly genuine. His usual elegance of speech seemed to be wearing thin in this encounter. He'd already made several embarrassing misjudgments.

"I'm not doing this for logical rea-

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sons," Turco finally said. "I'm doing it out of hatred for you and all the people who support you. What happened on Psyche was purely evil—useless, motivated by the worst intentions, resulting in the death of a beautiful dream, not to mention people I loved. No talk can change my mind about those things."

"Then why talk to me at all? I'm hardly the highest official in the Nexus."

"No, but you're in an ideal position to know who the higher officials involved were. You're a respected politician. And I suspect you had a great deal to do with suggesting the plot. I just want the truth. I'm tired. I'm going to rest for a few hours now."

"Wait a moment," Kollert said sharply. "We haven't discussed the most important things yet."

"I'm signing off. Until later."

The team leader made a cutting motion across his throat which almost made Kollert choke. The young bastard and his indiscreet symbols were positively obscene in the current situation. Kollert shook his head and held his fingertips to his temples. "We didn't even have time to begin," he said.

The team leader stood and stretched his arms.

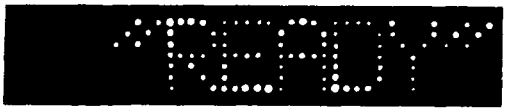
"You're doing quite well so far, Ser Kollert," he said. "It's best to ease into these things."

"I'm Advisor Kollert to you, and I don't see how we have much time to take it easy."

"Yes, sir. Sorry."

* * *

She needed the rest, but there was far too much to do. She pushed off from the seat and floated gently for a few moments before drifting down. The relaxation of weightlessness would have been welcome, and Psyche's pull was very weak, but just



enough to remind her there was no time for rest.

One of the things she had hoped she could do—checking the charges deep inside the asteroid to see if they were armed—was impossible. The main computer and the systems board indicated the transport system through the bore holes was no longer operative. It would take her days to crawl or float the distance down the shafts, and she wasn't about to take the small tug through a tunnel barely fifty meters wide. She wasn't that well-trained a pilot.

So she had a weak spot. The bombs couldn't be disarmed from where she was. They could be set off by a ship positioned along the axis of the tunnels, but so far none had shown up. That would take another twelve hours or so, and by then time would be running out. Hopefully all negotiations would be completed.

She desperately wanted out of the suit. The catheters and cups were itching fiercely, and she felt like a ball of tacky glue wrapped in wool. Her eyes were stinging from strain and sweat

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buildup on the lids. If she had a moment of bad irritation when something crucial was happening, she could be in trouble. One way or another, she had to clean up a bit—and there was no way to do that unless she risked exposure to the residue of drugs. She stood unsteadily for several minutes, vacillating, and finally groaned, slapping her thigh with a gloved palm. "I'm *tired*," something kept saying through her lips. "Not thinking straight."

She looked at the computer. There was a solution, but she couldn't make it clear in her head. "Come on, girl. So simple. But what?"

The drug would probably have a limited effective life, in case the Nexus wanted to do something with Psyche later. But how limited? Ten years? She chuckled grimly. She had the ampul and its cryptic chemical label. Would a Physician's Desk Reference be programmed into the computers?

She hooked herself into the console again. "PDR," she said. The screen was blank for a few seconds. Then it said, "Ready."

"Iropentaphonate," she said. "Two-seven diboltene."

The screen printed out the relevant data. She searched through the technical maze for a full minute before finding what she wanted. "Effective shelf-life: four months two days from date of manufacture." There it was.

She tested the air again—it was stale but breathable—and unhooked her helmet. It was worth any risk. A bare knuckle against her eye felt so good.

The small lounge in the Baja Sta-

tion was well-furnished and comfortable, but suited more for Geshels than Naderites—bright rather than natural colors, abstract paintings of a mechanistic tendency, modernist furniture. To Kollert it was faintly oppressive. The man sitting across from him had been silent for the past five minutes, reading through a sheaf of papers.

"Who authorized this?" the man asked.

"Hexamon Nexus, Mr. President."

"But who proposed it?"

Kollert hesitated. "The Advisory Committee."

"Who proposed it to the committee?"

"I did."

"Under what authority?"

"It was strictly legal," Kollert said defensively. "Such activities have been covered under Emergency Code, classified section fourteen."

The president nodded. "She came to the right man when she asked for you, then. I wonder where she got her information. None of this can be broadcast—why was it done?"

"There were a number of reasons,

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among them financial—"

"What kind? This was mostly financed by lunar agencies. Earth had perhaps a five percent share, so no controlling interest—and there was no connection with radical Geshel groups, therefore no connection with section fourteen on revolutionary deterrence. I read the codes, too, Farmer."

"Yes, sir."

"What were you afraid of? Some irrational desire to pin the butterflies down? Jesus God, Farmer, the Naderite beliefs don't allow anything like this. But you and your committee took it upon yourselves to covertly destroy the biggest project in the history of mankind. You think this follows in the tracks of the Good Man?"

"You're aware of lunar plans to build particle guidance guns. They're cancelled now, because Psyche is dead. They were to be used to push asteroids like Psyche into deep space, so advanced Beckmann drives could be used."

"I'm not technically minded, Farmer."

"Nor am I. But such particle guns could have been used as weapons—considering lunar sympathies, probably would have been used. They could cook whole cities on Earth. The development of potential weapons *is* a matter of concern for Naderites, sir. And there are many studies showing that human behavior changes in space. It becomes less Earth-centered, less communal. Man can't live in space and remain human. We were trying to preserve humanity's right to a secure future. Even now, the Moon is a potent political force, and war has been suggested by our strategists . . . it's a dire possibility. That was because of the separation of a group of humans from the parent body, from wise government and safe creed."

The president shook his head and looked away. "I am ashamed such a thing could happen in my government. Very well, Kollert, this remains your ballgame until she asks to speak to someone else. But my advisors are going to go over everything you say. I doubt you'll have the chance to botch anything. We're already acting with the Moon to stop this before it gets any worse. And you can thank God—for your life, not your career, which is already dead—that our Geshels have come up with a way out."

Kollert was outwardly submissive, but inside he was fuming. Not even the President of the Hexamon had the right to treat him like a child or, worse, a criminal. He was an independent advisor, of a separate Desk, elected by Naderites of high standing. The Ecumentalist Creed was apparently much tighter than the president's. "I acted in the best interests of my constituency," he said.

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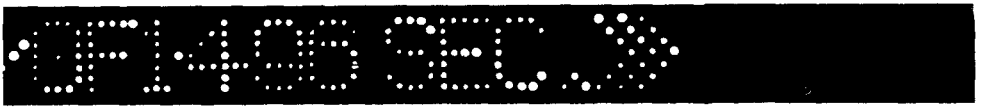

"You no longer have a constituency, you no longer have a career. Nor do any of the people who planned this operation with you, or those who carried it out. Up and down the line. A purge."

Turco woke up before the blinking light and moved her lips in a silent curse. How long had she been asleep? She panicked briefly—a dozen hours would be crucial—but then saw the digital clock. Two hours. The light was demanding her attention to an incoming radio signal.

There was no video image. Kollert's voice returned, less certain, almost cowed. "I'm here," she said, switching off her camera as well. The delay was a fraction shorter than when they'd first started talking.

"Have you made any decisions?" Kollert asked.

"I should be asking that question. My course is fixed. When are you and your people going to admit to sabotage?"

"We'd—I'd almost be willing to admit, just to—" He stopped. She was about to speak when he continued. "We could do that, you know. Broadcast a world-wide admission of guilt. A cheap price to pay for saving all life on Earth. Do you really understand what you're up to? What satisfaction, what revenge, could you possibly get out of this? My God, Turco, you—" There was a burst of static. It sounded suspiciously like the burst she had heard some time ago.

"You're editing him," she said. Her voice was level and calm. "I don't want anyone editing anything between us, whoever you are. Is that understood? One more burst of static like that and I'll . . ." She had already threatened the ultimate. "I'll be less tractable. Remember—I'm already a fanatic. Want me to be a hardened fanatic? Repeat what you were saying, Ser Kollert."

The digital readout indicated one way delay-time of 1.496 seconds. She would soon be closer to the Earth than the Moon was.

"I was saying," Kollert repeated, something like triumph in his tone, "that you are a very young woman, with very young ideas—like a child leveling a loaded pistol at her parents. You may not even be a fanatic. But you aren't seeing things clearly. We have no evidence here on Earth that you've found anything, and we won't have evidence—nothing will be solved—if the asteroid collides with us. That's obvious. But if it veers aside, goes into an Earth orbit perhaps, then an—"

"That's not one of my options," Turco said.

"—investigating team could reexamine the crew quarters," Kollert continued, not to be interrupted for a few

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seconds, "do a more detailed search. Your charges could be verified."

"I can't go into Earth orbit without turning around, and this is a one-way rock, remember that. My only other option is to swing around the Earth, be deflected a couple of degrees, and go into a solar orbit. By the time any investigating team reached me, I'd be on the other side of the Sun, and dead. I'm the daughter of a Geshel, Ser Kollert—don't forget that. I have a good technical education, and my training under Hexamon auspices makes me a competent pilot and spacefarer. Too bad there's so little long-range work for my type—just Earth-Moon runs. But don't try to fool me or kid me. I'm far more expert than you are. Though I'm sure you have Geshel people on your staff." She paused. "Geshels! I can't call you traitors—you in the background—because you might be thinking I'm crazy, out to destroy all of you. But do you understand what these men have done to our hopes and dreams? I've never seen a finished asteroid starship, of course—Psyche was to have been the first. But I've seen good simulations. It's like seven Shangri-las inside, hollowed out of solid rock and metal, seven valleys separated by walls four kilometers high, each self-contained, connected with the others by tube-trains. The valley floors reach up to the sky, like magic, everything wonderfully topsy-turvy. And quiet—so much insulation none of the engine sounds reach inside." She was crying again.

"Psyche would consume herself on the way to the stars. By the time she arrived, there'd be little left besides a cylinder thirty kilometers wide, and two hundred ninety long. Like the core of an apple, and the passengers would be luxurious worms—star travelers. Now ask why, *why* did these men sabotage such a marvelous thing? Because they are blind unto pure evil—blind, ugly-minded, weak men who hate big ideas . . ." She paused. "I don't know what you think of all this, but remember, they took something away from you. I know. I've seen the evidence here. Sabotage and murder." She pressed the button and waited wearily for a reply.

"Ser Turco," Kollert said, "you have ten hours to make an effective course correction. We estimate you have enough reaction mass left to extend your orbit and miss the Earth by about four thousand kilometers. There is nothing we can do here but try to convince you—"

She stopped listening, trying to figure out what was happening behind the scenes. Earth wouldn't take such a threat without exploring a large number of alternatives. Kollert's voice droned on as she tried to think of the most likely action, and the most effective.

She picked up her helmet and placed a short message, paying no attention to the transmission from Earth. "I'm going outside for a few minutes."

The acceleration had been steady

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for two hours, but now the weightlessness was just as oppressive. The large cargo handler was fully loaded with extra fuel and a bulk William Porter was reluctant to think about. With the ship turned around for course correction, he could see the Moon glowing with Earthshine, and a bright crescent so thin it was almost a hair.

He had about half an hour to relax before the real work began, and he was using it to read an excerpt from a novel by Anthony Burgess. He'd been a heavy reader all his memorable life, and now he allowed himself a possible last taste of pleasure.

Like most inhabitants of the Moon, Porter was a Geshel, with a physicist father and a geneticist mother. He'd chosen a career as a pilot rather than a researcher out of romantic predilictions established long before he was ten years old. There was something immediately effective and satisfying about piloting, and he'd turned out to be well suited to the work. He'd never expected to take on a mission like this. But then, he'd never paid much attention to politics, either. Even if he had, the disputes between Geshels and Naderites would have been hard to spot—they'd been settled, most experts believed, fifty years before, with the Naderites emerging as a ruling class. Outside of grumbling at restrictions, few Geshels complained. Responsibility had been lifted from their shoulders. Most of the population of both Earth and Moon was now involved in technical and scientific work, yet the mistakes they made would be blamed on Naderite policies—and the disasters would likewise be absorbed by the leadership. It wasn't a hard situation to get used to.

William Porter wasn't so sure, now, that it was the ideal. He had two options to save Earth, and one of them meant he would die.

He'd listened to the Psyche-Earth transmissions during acceleration, trying to make sense out of Turco's position, to form an opinion of her character and sanity, but he was more confused than ever. If she was right—and not a raving lunatic, which didn't seem to fit the facts—then the Hexamon Nexus had a lot of explaining to do, and probably wouldn't do it under the gun. The size of Turco's gun was far too imposing to be rational—the destruction of the human race, the wiping of a planet's surface.

He played back the computer diagram of what would happen if Psyche hit the Earth. At the angle it would strike, it would speed the rotation of the Earth's crust and mantle by an appreciable fraction. The asteroid would cut a gouge from Maine to England, several thousand kilometers long and at least a hundred kilometers deep. The impact would vault hundreds of millions of tons of surface material into space, and that would partially counteract the speedup of rotation. The effect would be a monumental jerk, with the energy finally being released as heat. The continents would fracture in several directions, forming new faults, even new plate orientations, which would generate

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earthquakes on a scale never before seen. The impact basin would be a hell of molten crust and mantle, with water on the perimeter bursting violently into steam, altering weather patterns around the world. It would take decades to cool and achieve some sort of stability.

Turco may not have been raving, but she was coldly suggesting a cataclysm to swat what amounted to a historical fly. That made her a lunatic in anyone's book, Geshel or Naderite. And his life was well worth the effort to thwart her.

That didn't stop him from being angry, though.

Kollert impatiently let the physician check him over and give him a few injections. He talked to his wife briefly, which left him more nervous than before, then listened to the team leader's theories on how Turco's behavior would change in the next few hours. He nodded at only one statement: "She's going to see she'll be dead, too, and that's a major shock for even the most die-hard terrorist."

Then Turco was back on the air and he was on stage again.

"I've seen your ship," she said. "I went outside and looked around in the direction where I thought it would be. There it was—treachery all around. Goddamned hypocrites! Talk friendly to the little girl, but shiv her in the back! Public face cool, private face snarl! Well, just remember, before he can kill me, I can destroy all controls to the positioning engines. It would take a week to rewire them. You don't have the time!" The beep followed.

"Giani, we have only one option left, and that's to do as you say. We'll admit we played a part in the sabotage of Psyche. It's confession under pressure, but we'll do it." Kollert pressed his button and waited, holding his full chin with one hand.

"No way it's so simple, Kollert. No public admission and then public denial after the danger is over—you'd all come across as heroes. No. There has to be some record-keeping, payrolls if nothing else. I want full disclosure of all records, and I want them transmitted around the world—facsimile, authenticated. I want uninvolved government officials to see them and sign that they've seen them. And I want the actual documents put on display where anyone can look at them—memos, plans, letters, whatever. All of it that's still available."

"That would take weeks," Kollert said, "if they existed."

"Not in this age of electronic wizardry. I want you to take a lie-detector test, authenticated by half a dozen experts with their careers on the line—and while you're at it, have the other officials take tests, too."

"That's not only impractical, it won't hold up in a court of law."

"I'm not interested in formal courts. I'm not a vengeful person, no matter what I may seem now. I just want the truth. And if I still see that goddamn ship up there in an hour, I'm going to stop negotiations right now and blow myself to pieces."

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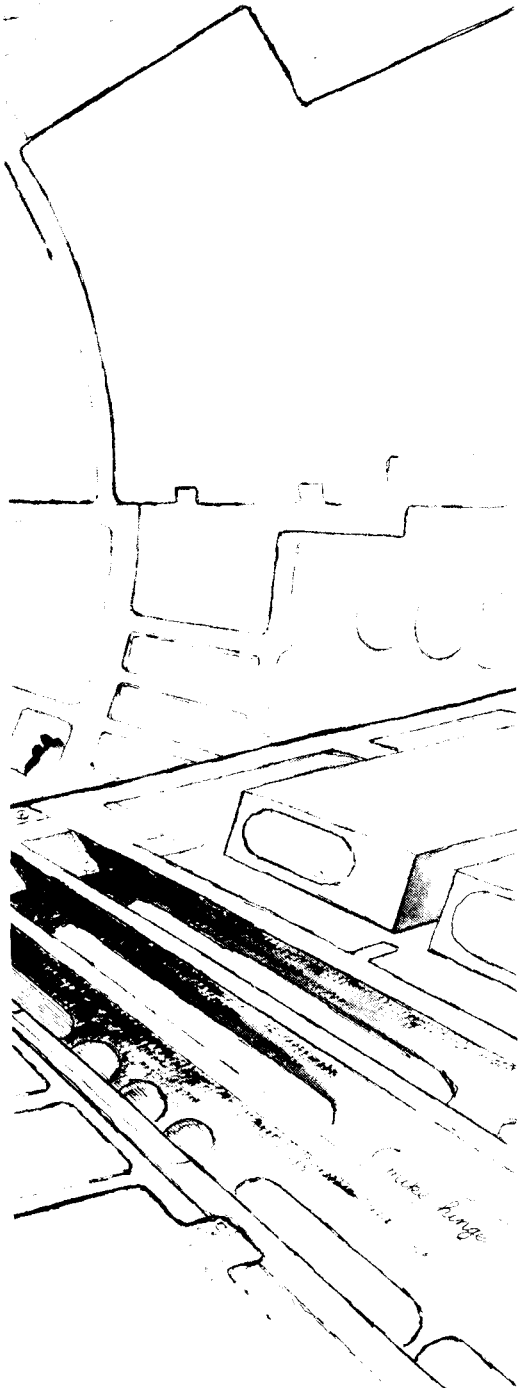

Kollert looked at the team leader, but the man's face was blank.

"Let me talk to her, then," Porter suggested. "Direct person-to-person. Let me explain the plans. She really can't change them any, can she? She has no way of making them worse. If she fires her engines or does any positive action, she simply stops the threat. So I'm the one who holds the key to the situation."

"We're not sure that's advisable, Bill," Lunar Guidance said.

"I can transmit to her without permission, you know," he said testily.

"Against direct orders, that's not like you."

"Like me, hell," he said, chuckling. "Listen, just get me permission. Nobody else seems to be doing anything effective." There was a few minutes' silence, then Lunar Guidance returned.

"Okay, Bill. You have permission. But be very careful what you say. Terrorist team officers on Earth think she's close to the pit."

With that obstacle cleared away, he wondered how wise the idea was in the first place. Still, they were both Geshels—they had something in common compared to the elite Naderites running things on Earth.

Far away, Earth concurred and transmissions were cleared. They couldn't censor his direct signal, so Baja Station was unwillingly cut from the circuit.

"Who's talking to me now?" Turco asked when the link was made.

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"This is Lieutenant William Porter, from the Moon. I'm a pilot—not a defense pilot usually, either. I understand you've had pilot's training."

"Just enough to get by." The lag was less than a hundredth of a second, not noticeable.

"You know I'm up here to stop you, one way or another. I've got two options. The one I think more highly of is to get in line-of-sight of your bore-holes and relay the proper coded signals to the charges in your interior."

"Killing me won't do you any good."

"That's not the plan. The fore end of your rock is bored with a smaller hole by thirty meters. It'll release the blast wastes more slowly than the aft end. The total explosive force should give the rock enough added velocity to get it clear of the Earth by at least sixty kilometers. The damage would be negligible. Spectacular view from Greenland, too, I understand. But if we've miscalculated, or if one or more charges doesn't go, then I'll have to impact with your aft crater and release the charge in my cargo hold. I'm one floating megaboom now, enough to boost the rock up and out by a few additional kilometers. But that means I'll be dead, and not enough left of me to memorialize or pin a medal on. Not too good, hm?"

"None of my sweat."

"No, I suppose not. But listen, sister—"

"No sister to a lackey."

Porter started to snap a retort, but stopped himself. "Listen, they tell me to be soft on you, but I'm under pressure, too, so please reciprocate. I don't see the sense in all of it. If you get your way, you've set back your cause by God knows how many decades—because once you're out of range and blown your trump, they'll deny it all, say it was manufactured evidence and testimony under pressure—all that sort of thing. And if they decide to hard-line it, force me to do my dirty work, or God forbid let you do yours—we've lost our home world. You've lost Psyche, which can still be salvaged and finished. Everything will be lost, just because a few men may or may not have done a very wicked thing. Come on, honey. That isn't the Geshel creed and you know it."

"What is our creed? To let men rule our lives who aren't competent to read a thermometer? Under the Naderites, most of the leaders on Earth haven't got the technical expertise to . . . to . . . I don't know what. To tie their goddamn shoes! They're blind, dedicated to some half-wit belief that progress is the most dangerous thing conceived by man. But they can't live without technology, so we provide it for them. And when they won't touch our filthy nuclear energy, we get stuck with it—because otherwise we all have to go back four hundred years, and sacrifice half the population. Is that good planning, sound policy? And if they do what I say, Psyche won't be damaged. All they'll have to do is fetch it back from orbit around the Sun."

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"I'm not going to argue on their behalf, sister. I'm a Geshel, too, and a Moonman besides. I never have paid attention to Earth politics because it never made much sense to me. But now I'm talking to you on a one-to-one basis. And you're trying to tell me that revenging someone's irrational system is worth wiping away a planet?"

"I'm willing to take that risk."

"I don't think you are. I hope you aren't. I hope it's all bluff and I won't have to smear myself against your backside."

"I hope you won't, either. I hope they've got enough sense down there to do what I want."

"I don't think they have, sister. I don't put much faith in them, myself. They probably don't even know what would happen if you hit the Earth with your rock. Think about that. You're talking about scientific innocents—flat-Earthers almost, naive. Words fail me. But think on it. They may not even know what's going on."

"They know. And remind them that if they set off the charges, it'll probably break up Psyche and give them a thousand rocks to contend with instead of one. That plan may backfire on them."

"What if they—we—don't have any choice?"

"I don't give a damn what choice you have," Turco said. "I'm not talking for a while. I've got more work to do."

Porter listened to the final click with a sinking feeling. She was a tough one. How would he psych her? He smiled grimly at his *chutzpah* for even thinking he could. She'd committed herself all the way—and now, perhaps, she was feeling the power of her position. One lonely woman, holding the key to a world's existence. He wondered what it felt like.

Then he shivered and the sweat in his suit felt very, very cold. If he would have a grave for someone to walk over. . .

For the first time, she realized they wouldn't accede to her demands. They were more traitorous than even she could have imagined. Or—the thought was too horrible to accept—she'd misinterpreted the evidence and they weren't at fault. Perhaps a madman in the Psyche crew had sought revenge and caused the whole mess. But that didn't fit the facts. It would have taken at least a dozen people to set all the psychotropic vials and release them at once—a concerted, preplanned effort. She shook her head. Besides, she had the confidential reports a friend had accidentally plugged into while troubleshooting a Hexamon computer plex. There was no doubt about who was responsible, just uncertainty about the exact procedure. Her evidence for Farmer Kollert's guilt was circumstantial, but not baseless.

She sealed her suit and helmet and went outside the bubble again, just to watch the stars for a few minutes. The lead-gray rock under her feet was pitted by eons of micrometeoroids. Rills several kilometers across attested

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to the rolling impacts of other asteroids, any one of which would have caused a major disaster on Earth. Earth had been hit before, not often by pieces as big as Psyche, but several times at least, and had survived. Earth would survive Psyche's impact and life would start anew. Those plants and animals—even humans—which survived would eventually build back to the present level, and perhaps it would be a better world, more daunted by the power of past evil. She might be a force for positive regeneration.

The string of bubbles across Psyche's surface was coldly pretty in the starlight. The illumination brightened slowly as Earth rose above the Vlasseg pole, larger than the Moon now. She had a few more hours to make the optimum correction. Just above the Earth was a tiny moving point of light—Porter in his cargo vessel. He was lining up with the smaller bore hole to send signals, if he had to.

She wanted to cry again. She felt like a little child, full of hatred and frustration, but caught now in something so immense and inexorable that all passion was dwarfed. She couldn't believe she was the controlling factor, that she held so much power. Surely something was behind her, some impersonal, objective force. Alone she was nothing, and her crime would be unbelievable—just as Porter had said. But with a cosmic justification, the agreeing nod of some vast, all-seeing God, she was just a tool, bereft of responsibility.

She grasped the guide wires strung between the bubbles and pulled herself back to the airlock hatch. With one gloved hand she pressed the button. Under her palm she felt the metal vibrate for a second, then stop. The hatch was still closed. She pressed again and nothing happened.

Porter listened carefully for a full minute, trying to pick up the weak signal. It had cut off abruptly a few minutes before, during his final lineup with the bore-hole through the Vlasseg pole. He called his director and asked if any signals had been received from Turco. Since he was out of line-of-sight now, the Moon had to act as a relay.

"Nothing," Lunar Guidance said. "She's been silent for an hour."

"That's not right. We've only got an hour and a half left. She should be playing the situation for all it's worth. Listen, LG, I received a weak signal from Psyche several minutes ago. It could have been a freak, but I don't think so. I'm going to move back to where I picked it up."

"Negative, Porter. You'll need all your reaction mass in case plan A doesn't go off properly."

"I've got plenty to spare, LG. I have a bad feeling about this. Something's gone wrong on Psyche." It was clear to him the instant he said it. "Jesus Christ, LG, the signal must have come from Turco's area on Psyche! I lost it just when I passed out of line-of-sight from her bubble."

Lunar Guidance was silent for a long moment. "Okay, Porter, we've

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got clearance for you to regain that signal."

"Thank you, LG." He pushed the ship out of its rough alignment and coasted slowly away from Psyche until he could see the equatorial ring of domes and bubbles. Abruptly, his receiver picked up the weak signal again. He locked his tracking antenna to it, boosted it, and cut in the communications processor to interpolate through the hash.

"This is Turco. William Porter, listen to me! This is Turco. I'm locked out. Something has malfunctioned in the control bubble. I'm locked out . . ."

"I'm getting you, Turco," he said. "Look at my spot above the Vlasseg pole. I'm in line-of-sight again." If her suit was a standard model, her transmissions would strengthen in the direction she was facing.

"God bless you, Porter. I see you. Everything's gone wrong down here. I can't get back in."

"Try again, Turco. Do you have any tools with you?"

"That's what started all this, breaking in with a chisel and a pry bar. It must have weakened something and now the whole mechanism is frozen. No. I left the bar inside. No tools. Jesus, this is awful."

"Calm down. Keep trying to get in. I'm relaying your signal to Lunar Guidance and Earth." That settled it. There was no time to waste now. If she didn't turn on the positioning motors soon, any miss would be too close for comfort. He had to set off the internal charges within an hour and a half for the best effect.

"She's outside?" Lunar Guidance asked when the transmissions were relayed. "Can't get back in?"

"That's it," Porter said.

"That cocks it, Porter. Ignore her and get back into position. Don't bother lining up with the Vlasseg pole, however. Circle around to the Janacki pole bore-hole and line up for code broadcast there. You'll have a better chance of getting the code through, and you can prepare for any further action."

"I'll be cooked, LG."

"Negative—you're to relay code from an additional thousand kilometers, and boost yourself out of the path just before detonation. That will occur—let's see—about four point three seconds after the charges receive the code. Program your computer for sequencing; you'll be too busy."

"I'm moving, LG." He returned to Turco's wavelength. "It's out of your hands now," he said. "We're blowing the charges. They may not be enough, so I'm preparing to detonate myself against the Janacki pole crater. Congratulations, Turco."

"I still can't get back in, Porter."

"I said, congratulations. You've killed both of us, and ruined Psyche for any future projects. You know that she'll go to pieces when she drops below Roche's limit? Even if she misses, she'll be too close to survive. You know, they might have gotten it all straightened out in a few administrations. Politicos die, or get booted

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out of office—even Naderites. I say you've cocked it good. Be happy, Turco." He flipped the switch viciously and concentrated on his approach program display.

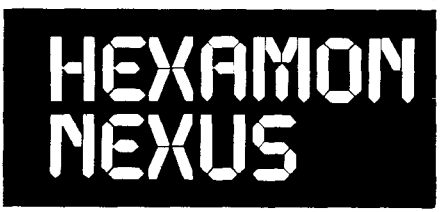
Farmer Kollert was slumped in his chair, eyes closed but still awake, half-listening to the murmurs in the control room. Someone tapped him on the shoulder and he started, jerking up in his seat.

"I had to be with you, Farmer." Gestina stood over him, a nervous smile making her dimples obvious. "They brought me here to be with you."

"Why?" he asked.

Her voice shook. "Because our house was destroyed. I got out just in time. What's happening, Farmer? Why do they want to kill me? What did I do?"

The team officer standing beside her held out a piece of paper and Kollert took it. Violence had broken out in half a dozen Hexamon centers,



and numerous officials had had to be evacuated. Geshels weren't the only ones involved—Naderites of all classes seemed to share indignation and rage at what was happening. The outbreaks weren't organized—and that was even more disturbing. Wherever transmissions had reached the unofficial grapevines, people were reacting.

Gestina's large eyes regarded him without comprehension, much less sympathy. "I had to be with you, Farmer," she repeated. "They wouldn't let me stay."

"Quiet, please," another officer said. "More transmissions coming in."

"Yes," Kollert said softly. "Quiet. That's what we wanted. Quiet and peace and sanity. Safety for our children to come."

"I think something big is happening," Gestina said. "What is it?"

Porter checked the alignment again, put up his visual shields and instructed the processor to broadcast the coded signal. With no distinguishable pause, the ship's engines started to move him out of the particle blast.

Giani Turco worked at the hatch edge with a bit of metal bracing she had broken off her suitpack. The sharp edge just barely fit into the crevice, and by gouging and prying she had managed to force the door up half a centimeter. The evacuation mechanism hadn't been activated, so frosted air hissed from the crack, making the work doubly difficult. The Moon was rising above the Janacki pole.

Deep below her, seven prebalanced but unchecked charges, mounted on massive fittings in their chambers, began to whir. Four processors checked the timing, concurred, and released safety shields.

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Six of the charges went off at once. The seventh was late by ten thousandths of a second, and its blast was muted as the casing melted prematurely. The particle shockwaves streamed out through the bore-holes, now pressure release valves, and formed a long neck and tail of flame and ionized particles which grew steadily for a thousand kilometers, then faded. The neck from the Vlasseg pole was thinner and shorter, but no less spectacular. The asteroid shuddered, vibrations rising from deep inside to pull the ground away from Turco's boots, then swing it back to kick her away from the bubble and hatch. She floated in space, disoriented, ripped free of the guide wires, her back to the asteroid, faceplate aimed at peaceful stars, turning slowly as she reached the top of her arc.

Her leisurely descent gave her plenty of time to see the secondary plume of purple and white and red forming around the Janacki pole. The stars were blanked out by its brilliance. She closed her eyes. When she opened them again she was nearer the ground, and her faceplate had polarized against the sudden brightness. She saw the bubble still intact, and the hatch wide open now. It had been jarred free. Everything was vibrating and with shock she realized the asteroid was slowly moving out from beneath her. Her fall became a drawn-out curve, taking her away from the bubble, toward a ridge of lead-gray rock, without guide wires, where she would bounce and continue on unchecked. To her left, one dome ruptured and sent a feathery wipe of debris into space. Pieces of rock and dust floated past her, shaken from Psyche's weak surface grip. Then her hand was only a few meters from a guide wire torn free and swinging outward. It came closer like a dancing snake, hesitated, rippled again, and came within reach. She grabbed it and pulled herself down.

"Porter, this is Lunar Guidance. Earth says the charges weren't enough. Something went wrong."

"She held together, LG," Porter said in disbelief. "She didn't break up. I've got a fireworks show like you've never seen before."

"Porter, listen. She isn't moving fast enough. She'll still impact."

"I *heard* you, LG," Porter shouted. "I heard! Leave me alone to get things done." And nothing more was said between them.

Turco reached the hatch and crawled into the airlock, exhausted. She closed the outer door and waited for equalization before opening the inner. Her helmet was off and floating behind as she walked and bounced and guided herself into the control room. If the motors were still functional, she'd fire them. She had no second thoughts now. Something had gone wrong, and the situation was completely different.

In the middle of the kilometers-wide crater at the Janacki pole, the bore-hole was still spewing debris and

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ionized particles. But around the perimeter, other forces were at work. Canisters of reaction mass were flying to a point three kilometers above the crater floor. The Beckmann drive engines rotated on their mountings, aiming their nodes at the canisters' rendezvous point.

Porter's ship was following the tail of debris down to the crater floor. He could make out geometric patterns of insulating material. His computers told him something was approaching a few hundred meters below. There wasn't time for any second guessing. He primed his main cargo and sat back in the seat, lips moving, not in prayer, but repeating some stray, elegant line from the Burgess novel, a final piece of pleasure.

One of the canisters struck the side of the cargo ship just as the blast began. A brilliant flare spread out above the crater, merging with and twisting the tail of the internal charges. Four canisters were knocked from their course and sent plummeting into space. The remaining six met at the assigned point and were hit by beams from the Beckmann drive nodes. Their matter was stripped down to pure energy.

All of this, in its lopsided, incomplete way, bounced against the crater floor and drove the asteroid slightly faster.

When the shaking subsided, Turco let go of a grip bar and asked the computers questions. No answers came back. Everything except minimal life support was out of commission. She thought briefly of returning to her tug, if it was still in place, but there was no place to go. So she walked and crawled and floated to a broad view-window in the bubble's dining room. Earth was rising over the Vlasseg pole again, filling half her view, knots of storm and streaks of brown continent twisting slowly before her. She wondered if it had been enough—it hadn't felt right. There

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was no way of knowing for sure, but the Earth looked much too close.

"It's too close to judge," the president said, deliberately standing with his back to Kollert. "She'll pass over Greenland, hopefully just hit the upper atmosphere, perhaps lose bits of herself."

The terrorist team officers were packing their valises and talking to each other in subdued whispers. Three of the president's security men were looking at the screen with dazed expressions. The screen was blank except for a display of seconds until accession of picture. Gestina was asleep in the chair next to Kollert, her face peaceful, hands wrapped together in her lap.

"We'll have relay pictures from Iceland in a few minutes," the president

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said. "Should be quite a sight." Kollert frowned. The man was almost cocky, knowing he would come through it untouched. Even with survival uncertain, his government would be preparing explanations. Kollert could predict the story: a band of lunar terrorists, loosely tied with Giani Turco's father and his rabid spacefarers, were responsible for the whole thing. It would mean a few months of ill-feeling on the Moon, but at least the Nexus would have found its scapegoats.

A communicator beeped in the room and Kollert looked around for its source. One of the security men reached into a pocket and pulled out a small earplug, which he inserted. He listened for a few seconds, frowned, then nodded. The other two gathered close and they whispered.

Then, quietly, they left the room. The president didn't notice they were gone, but to Kollert their absence spoke volumes.

Six Nexus police entered a minute later. One stood by Kollert's chair, not looking at him. Four waited by the door. Another approached the president and tapped him on the shoulder. The president turned.

"Sir, fourteen Desks have requested your impeachment. We're instructed to put you under custody, for your own safety."

Kollert started to rise, but the officer beside him put a hand on his shoulder.

"May we stay to watch?" the president asked. No one objected.

Before the screen was switched on, Kollert asked, "Is anyone going to get Turco, if it misses?"

The terrorist team leader shrugged when no one else answered. "She may not even be alive."

Then, like a crowd of children looking at a horror movie, the men and women in the communications center grouped around the large screen and watched the dark shadow of Psyche blotting out stars.

From the bubble window, Turco saw the sudden aurorae, the spray of ionized gases from the Earth's atmosphere, the awesomely rapid passage of the ocean below, and the blur of white as Greenland flashed past. The structure rocked and jerked as the Earth exerted enormous tidal strains on Psyche.

Sitting in the plastic chair, numb, tightly gripping the arms, Giani looked up—down—at the bright stars, feeling Psyche die beneath her.

Inside, the still-molten hollows formed by the charges began to collapse. Cracks shot outward to the surface, where they became gaping chasms. Sparks and rays of smoke jumped from the chasms. In minutes the passage was over. Looking closely, she saw roiling storms forming over Earth's seas, and the spreading shockwave of the asteroid's sudden atmospheric compression. Big winds were blowing, but they'd survive.

It shouldn't have gone this far. They should have listened reasonably, admitted their guilt—

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Absolved, girl, she wanted her father to say. She felt him very near. *You've destroyed everything we worked for—a fine architect of Pyrrhic victories.* And now he was at a great distance, receding.

The room was cold and her skin tingled.

One huge chunk rose to block out the Sun. The cabin screamed and the bubble was filled with sudden flakes of air. ■

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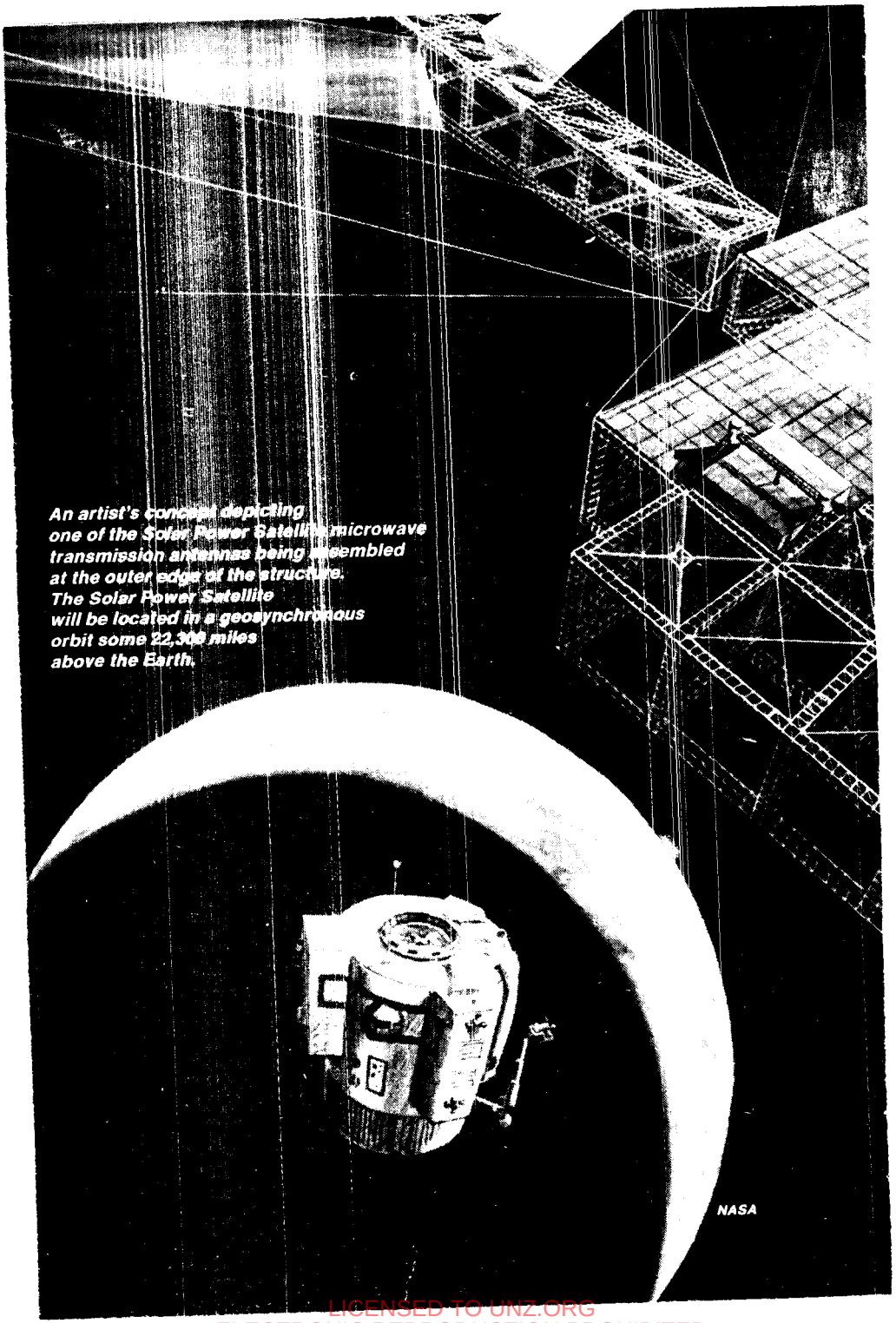

An artist's concept depicting one of the Solar Power Satellite microwave transmission antennas being assembled at the outer edge of the structure. The Solar Power Satellite will be located in a geosynchronous orbit some 22,300 miles above the Earth.

NASA

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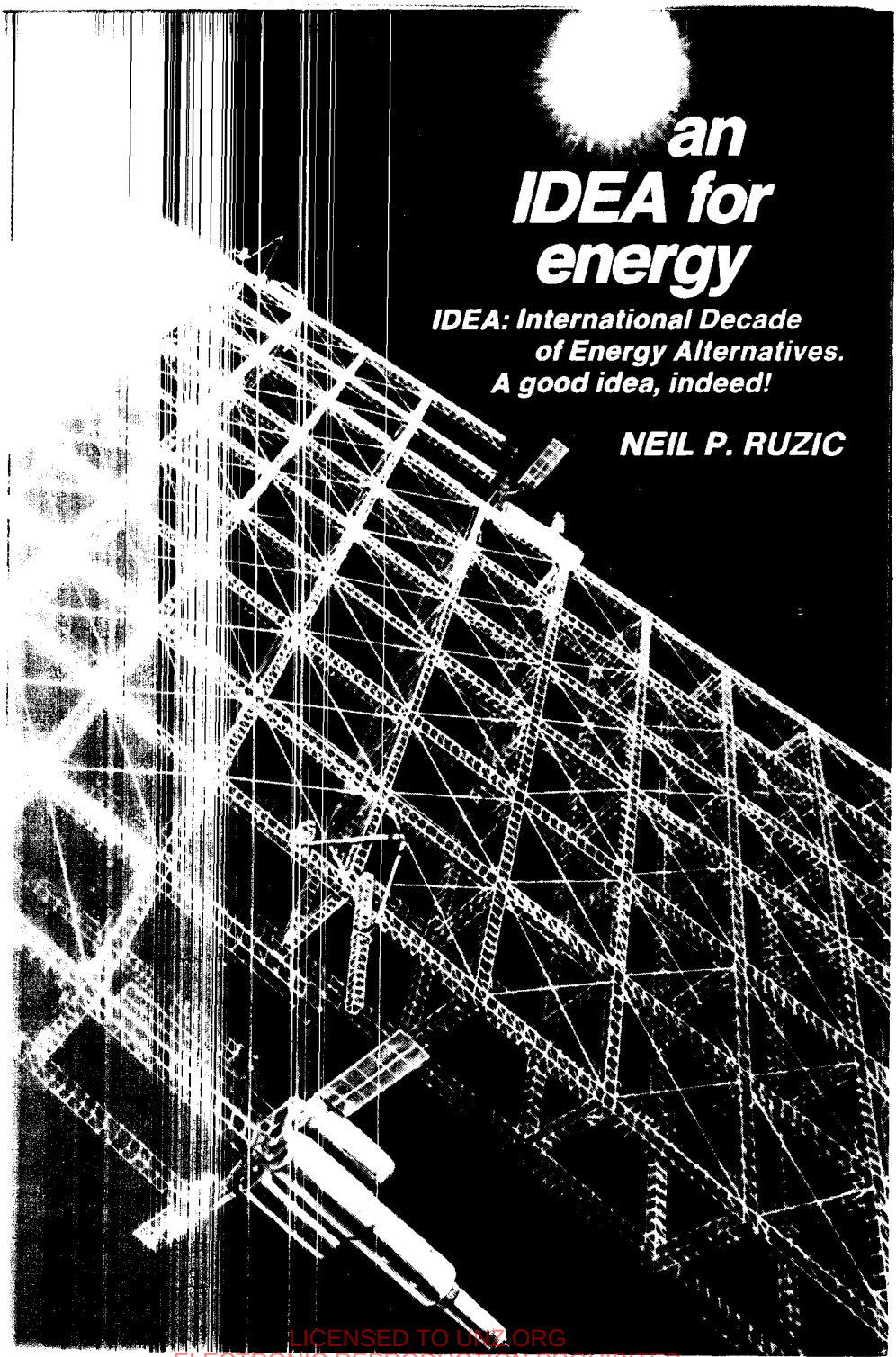

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Man's need for energy is expanding so fast that alarming environmental, social, and economic dislocations are being created. Despite attempts at conservation, the most rational forecasts indicate that the United States will—and should—consume more energy between now and the end of the century than it has in its entire history. And while we will almost double our annual consumption, the worldwide demand will almost triple. If you express world energy consumption in electrical terms, assuming all energy is converted into electricity on the basis of one quadrillion British Thermal Units equaling one hundred billion kilowatt hours, you can compare where we stand today and where we are likely to be by the year 2000, barring world nuclear war or other planetary catastrophe. We stand today at a world consumption level of twenty-eight trillion kilowatt hours a year; by 2000 it will grow to the electrical equivalent of seventy trillion kilowatt hours. The United States annually consumes some eight trillion kilowatt hours today and will devour fifteen trillion by century's end, decreasing from thirty-two percent to twenty-one percent as the rest of the world tends to catch up in affluence.

Many scientists and engineers, especially those of us involved with the space program, believe it is wasteful to maintain a vast but increasingly unused space technology while at the same time suffering a worldwide energy shortage, without employing the first to solve the second. We also believe that the demand for energy will be sufficiently enormous that only nuclear power or solar energy at an off-planet location can fill the need for future generations. Building solar power satellites to supplant a significant portion of dwindling petroleum supplies is by no means an easy job. In the final analysis, after all the feasibility studies are done and pilot satellites launched, it may prove less economical than nuclear energy. On the other hand, powersats may well solve the world's energy problem for all time—or at least until fusion power is possible—with an inexhaustible, pollution-free, highly flexible, and ultimately cheap energy source. As an international peace-time program of unprecedented magnitude and utility, powersats also may contribute materially to world peace, or at least to a strengthened Western world.

How are we to know which road will lead to energy freedom?

One way is to begin an International Decade of Energy Alternatives (IDEA). By devoting the entire decade of the 1980s to international planning, research, and phasing of the various energy alternatives, we can multiply the chances of achieving energy abundance. Any plan with the potential of assuring world economic growth and altering the status quo toward peace deserves the intensive debate, international scope, and cost-sharing inherent in the concept of ten years focused on energy alternatives.

We have had "international decades" before, for geophysics first and

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now for ocean exploration. These programs were designed to acquire scientific and technological information as an underpinning for resource utilization on a global scale. The emphasis during the International Decade of Energy Alternatives, however, will be on achievement of devices and proved systems rather than mere acquisition of information. (The "International Decade of Energy Achievement" is an alternate acronym.) There is another difference too. Without in any way denigrating the value of geophysical or ocean resources, a decade of alternative energy achievement is of much greater immediacy and world importance. To evaluate this particular approach to a highly complex set of problems, it is necessary to ask what are the energy alternatives to petroleum shortages and how can the IDEA strengthen the selection, internationalization, and implementation of the best of them.

The first alternative is whether to place the major emphasis on conservation, as President Carter would have us do, or on continued growth, as most industrialists want. While it is true that the United States consumes about thirty-two percent of the world's energy, we also produce thirty-one percent of the world's goods and services, and so the notion that we waste more than other countries is untrue proportionately. There should be little argument that growth of energy, *if achievable* without disrupting our economy, is the safer, wiser, more desirable course. Conservation alone can easily lose vital industrial production, diminish our preeminence in world affairs, and force a progressively lower standard of living on future generations. The question is whether continued energy growth can be achieved in the face of dwindling oil reserves; the potential rape of the landscape inherent in strip coal mining, which is how most of our vast coal reserves must be harvested; and the overriding danger of atomic weapons proliferation through the chemical extraction of plutonium from spent nuclear fuel. Eventually, of course, even coal will be depleted. Technical alternatives to fossil fuels include wind power, sea-thermal and ocean-current energy, biomass energy such as growing blue-green algae to synthesize oil, extraction of oil shale, and thermonuclear or fusion power. All are possible but none is feasible, either to go on stream by the year 2000 or else, if one can, to supply a significant enough portion of global energy needs. But at least five other major energy sources do have that potential. One or more of them can be readily available by the year 2000, provided we make the critical research and development choices now. A brief description is offered below, followed by a table showing comparative costs for research, construction, the resultant energy, and associated deaths in operating each plant over a projected thirty-year lifetime. From the least complex to the most, they are:

(1) *Low-energy coal gasification.* In the cleanest coal plant imaginable,

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coal is converted to low-energy gas which fuels a combined gas turbine and steam plant. Almost all (ninety-nine point seven percent) of the sulfur oxides are removed from the coal. This method was chosen from among other coal plants because it is the cleanest and costs only a third more than the cheapest sulfur-removal approach.

(2) *Light-water nuclear reactor.* This ordinary-water reactor uses uranium oxide fuel processed from sandstone ore and enriched with two to four percent fissionable uranium-235. Boiling water carries the heat from the reactor core to a steam plant, which generates electricity with a thirty-two percent conversion efficiency. The spent fuel cannot be easily processed to make atomic bombs.

(3) *Ground-based solar thermal plants,* now undergoing limited prototype development by the Energy Research & Development Administration (ERDA). A ten megawatt power plant at Barstow, California will be operational by 1980. (A megawatt is one million watts or one thousand kilowatts.) This type of plant consists of a vast field of flat mirrors, or heliostats, that reflect solar energy and trap it in a central receiver. The heat produces steam as in a coal boiler or reactor core: the steam is expanded through a turbine that runs a generator to produce electrical power. Since the Sun shines only in the daytime, storage capacity is required or else a coal or nuclear backup plant will have to be combined (gasified coal backup is compared in the cost analysis table on page 47).

The alternative to the night-and-cloud problem is to place the solar converters in space where they will bask in sunshine one hundred percent of the time (or ninety-nine percent if in geosynchronous orbit, due to daily eclipses).

(4) *Geosynchronous solar satellite stations.* These are satellites placed in an orbit more than 22,000 miles high and traveling the same speed as the Earth rotates, so that they appear stationary relative to a fixed point on the ground. The concept was evolved for the National Aeronautics & Space Administration (NASA) by a team consisting of Arthur D. Little Inc. (headed by Dr. Peter E. Glaser, vice president of engineering sciences), Grumman Aerospace Corp., Raytheon Co., and the Spectrolab division of Textron Inc. Giant arrays several miles wide form each satellite, which will look through a small telescope more like thin slices of football fields hovering in space instead of the conventional spherical satellites we have grown accustomed to. But at this altitude each satellite would appear to the naked eye as a star, albeit one you could see in the daytime. The satellites will collect solar energy, concentrate it slightly (two to one) onto thin "photovoltaic" cells that convert sunlight directly into electricity, collect the resulting direct current at voltages of about twenty kilovolts and carry it across a rotating joint to a transmitter that changes the direct current to

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microwave energy. A coherent microwave beam is transmitted to ground-receiving antennas called "rectennas." These are spread out in circles several miles in diameter on the outskirts of major cities.

The microwave transmission from space to Earth will operate at least at an eighty-two percent efficiency. We know this for certain because that was the efficiency attained in a dramatic Jet Propulsion Laboratory demonstration in the summer of 1975, in which microwave energy was transmitted across one mile of air at Goldstone, California and then converted to electricity. Transmission through space will be even more efficient, although the atmosphere attenuates, or weakens, the beam somewhat so that about ten percent of the energy is lost.

In a variation of the photovoltaic satellite plan, designed by Gordon R. Woodcock and D. L. Gregory of the Boeing Co., thousands of acres of plastic film mirrors concentrate sunlight into a solar cavity. Solar photovoltaic cells are not used. Only the heat is used to drive a set of helium gas turbines that turn alternators. The turbine heat-engine converters require no technological improvements, as do photovoltaic cells, which need to be made thinner and more efficient for serious consideration in space.

Once the electric power is generated—whether by heat engine or by solar cells—it is routed to a radio-frequency generator where it is converted to microwaves. The narrow microwave beam can be directed to any point on Earth visible to the satellite simply by swiveling the transmitter antenna a few degrees. Microwave power can be broadcast day and night, rain and shine. Hence storage of the energy is unnecessary. The microwave energy cannot harm people in airplanes flying through the beams because of the metal shielding and brief exposures. On the ground, the energy is too diffuse to harm human beings in the area adjacent to the rectennas or under them; it is well within international standards of ten milliwatts per square centimeter imposed for microwave ovens. In fact, the big dish rectennas can be elevated for frost-free farming of the ground beneath. The rectennas are not solid dishes, but consist of open grids that cause only partial shading below; some crops, such as tobacco, prefer shade. Alternatively the rectennas can be integrated into a roof structure over a city of the geodesic type recommended by R. Buckminster Fuller for Manhattan in which, he calculates, the cost of a two-mile diameter dome could be recovered in ten years from the savings in snow removal alone, besides additional savings in heating and cooling due to the reduced surface area of the city. Some ornithologists, though, are concerned that the microwaves will distress or kill birds that fly into the beams. Birds, after all, don't have the protection of metal airplanes to shield them. But this possibility seems to be almost exactly balanced by other scientists who think that the birds will be *attracted* to the beams, especially in

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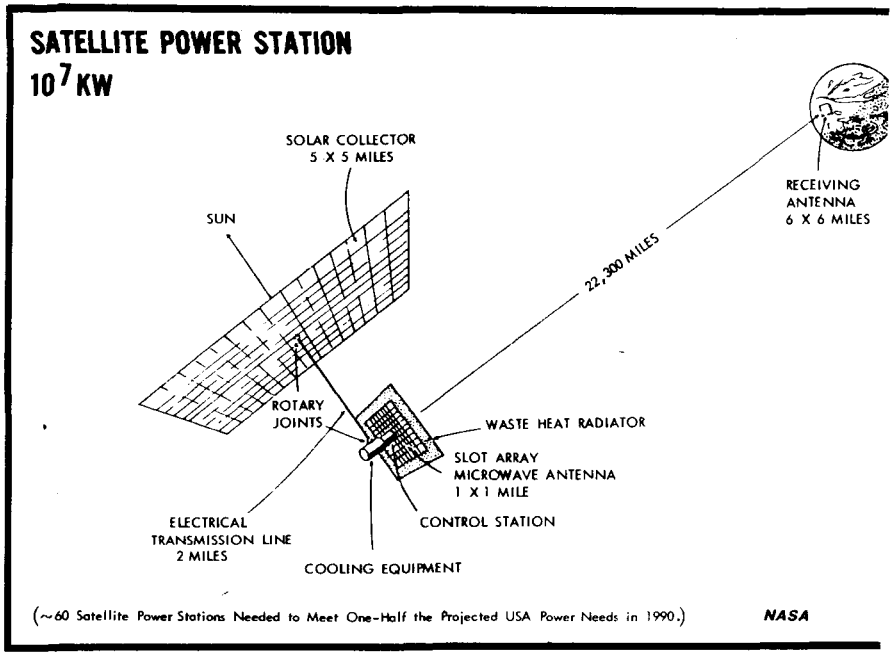

Figure 1: A study to explore the feasibility of using large satellites at synchronous altitude to beam down electrical energy for power needs on Earth will be carried out for NASA.

the winter, because the microwaves will impart a pleasant warming sensation. Either way, the problem is important since it could change the local ecology, but does not present a serious obstacle because, if necessary, bird screens could be erected around the rectennas to the height of bird altitudes.

(5) *Low-orbit solar satellites,* devised by Dr. James E. Drummond, director of plasma engineering at Maxwell Laboratories Inc. Instead of a twenty-two thousand mile geosynchronous orbit, the powersats are orbited at about twenty-nine hundred miles. Enough satellites in two belts at plus and minus forty-five degrees to the plane of the ecliptic can service any point on Earth, unlike geosynchronous satellites, which are limited to areas between seventy degrees north and south latitudes (which of course isn't much of a limitation). You would see the low-orbit powersats dimly from the ground as widely spaced dotted lines of tiny squares following the path of the Sun, each line forty-five degrees on either side of that path, the square dots changing into slivers

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as they recede into the horizon. At night they will be faint, for most of their sunlight will be reflected back toward the Sun.

Dr. Drummond also suggests a new conversion system now in the conceptual design stage called "cascaded dielectric power conversion." The system is a closed-cycle thermal converter similar to Woodcock's and Gregory's, but it eliminates their bulky and heavy mechanical turbines. Heat is converted directly to electricity by depolarizing a thin piece of dielectric, or nonconducting, material within a capacitor, or device for storing a charge of electricity. As the moments of the dipole (two magnetic poles of opposite sign) become unaligned with the electric field, they release electrons held on one plate of the capacitor. The electrons are allowed to flow through an external circuit to replace a deficiency of electrons which the polarization had helped to maintain at the opposite plate, thus generating current.

As might be expected, the direct cost of these five viable technologies increases with their scientific sophistication (except, possibly, for the last, which may turn out to be as relatively cheap as shown below). The costs are compared in the table that follows, adapted from a remarkable document issued in March 1977 and prepared by Mr. Richard Caputo, project engineer at NASA's Jet Propulsion Laboratory. It is called "An Initial Comparative Assessment of Orbital and Terrestrial Central Power Systems." Plan No. 5, below, was estimated by the author on the basis of Dr. Drummond's submission to the House Committee on Science & Technology last year. These cost figures are open to debate but derive from a well-reasoned set of voluminous assumptions.

Type of Power System	*Research & Development*	*Construction*	*Cost of Energy at Ground before Distrib.*	*Proj. Deaths (30 Yrs)*
1 Coal low-energy gasification	$1.5-billion	$1150/kW	0.6¢/kWH	530
2 Nuclear light-water reactor	1.4-billion	2280/kW	0.8¢/kWH	51
3 Solar ground-thermal with coal backup	1.1-billion	3600/kW	0.9¢/kWH	8
4 Solar geosynchronous orbit, photovoltaic or thermal	60-billion	5600/kW	1.2¢/kWH	?
5 Solar low-orbit with cascaded dielectric conversion	60-billion	2800/kW	1.0¢/kWH	?

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They will suffice for our purposes to show the kinds of economic and social costs associated with the five power systems selected.

"Projected deaths" are only part of the health effects estimated, but they are proportionate to some of the others such as "person days lost." Deaths, from accident or disease, were calculated from past experience with power plants in various stages such as construction, fuel harvesting, conversion to electricity, and final wastes. Since no experience exists for large-scale plants in orbit, the death projection for powersats is unknown.

On the strength of the strictly economic portion of the cost analysis, coal gasification, light-water nuclear reactors, and combined solar-thermal/coal plants on the ground appear warranted, whereas orbital power stations do not. Indeed ERDA now is headed in this direction.

Have we arrived at the end of the story? Or is there a danger in isolating the "cost" of any of these mammoth systems from the environmental, world-political, and other factors that the systems themselves influence? I submit there is very much a danger. My argument is not that cost is an improper tool for assessing which technology to choose. It is an excellent tool. But *all* likely costs to society must be taken into account.

A simple thought experiment may be useful in pointing out the fallacy in any line of reasoning that attempts to insulate the cost of a future power system from the cost of conditions it helps bring about. "Thought experiments," besides being cheaper than real experiments, were devised by scientists to reveal how events affect each other. The idea is to invent an imaginary situation in which chains of events lead to logical conclusions, pointing up contradictions or absurdities in some theory or plan. My thought experiment traces the financial and social condition of the world through two extreme scenarios, both of which "solve" the U.S. energy shortage:

(A) *Input:* A few years from now, orbital solar power is ruled out after various studies show it to be "uneconomical." The NASA budget erodes further from its present level of $3.8-billion this year (from a high of $5.3-billion in 1965). NASA's scientific and engineering capability decreases much more than proportionately since a certain minimum is required simply to keep facilities operating, and research and development is the only place to cut. ERDA places major emphasis on nuclear power. At first, light-water reactors are built that use enriched uranium oxide as fuel. The light-water reactor is chosen because it kills fewer people than goal gasification, costs only slightly more, and among all nuclear alternatives it lessens the danger that fissionable wastes will proliferate for weapons. Soon, however, by 1990, we begin to deplete our uranium-235 resource. It is now too late to consider powersats because NASA's level of effort is reduced to

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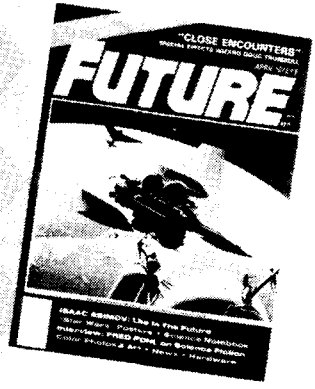

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$2-billion and the agency primarily serves the Departments of Transportation, Housing & Urban Development, and others in addition to conducting space science and aeronautics studies. Since a commitment had been made to nuclear power as the major supplement of fossil fuels, since no detrimental health effects or serious accidents have occurred, and since the swelling of energy demand continues unabated, another move—this time toward hard-core nuclear energy—is "forced," as chess players say. A commitment now is made to the liquid metal fast breeder reactor that converts the more plentiful U-238 to plutonium and is completely independent of depleted U-235 resources. Liquid metals carry the heat from the reactor core to a steam plant where it is converted to electricity with a thirty-nine percent efficiency.

Result: At the year 2000, we finally approach energy independence in the United States, with the majority of our electric power derived from nuclear reactors, of which many of the new ones are breeders. The other less energy-rich nations become more and more restive. The first atomic bomb homemade from stolen plutonium is exploded as an outgrowth of a riot in Panama over the fate of the second hundred years of the Canal. The next fifteen bombs determine the survivor of the first (and last) Israel-Arab War of the twenty-first century, a one-day war. The Pentagon wonders whether massive nuclear retaliation even can be a deterrent when there is doubt as to the origin of enemy missiles. . . .

(B) In the second scenario of my thought experiment, we opt for "best over cheapest" and "global over national." *Input:* Since we cannot afford the enormous expense of building power satellites alone, and since it would not gain us much if we relieved our own energy shortage while our trading partners remained shackled to oil (and to the oil cartel), we internationalize the program. After a decade of satellite prototypes and of progress in reducing the weight and multiplying the efficiency of solar cells, we begin to launch very large satellites from Cape Canaveral. They are assembled in space using space shuttles and paid for one-third by the U.S. and two thirds by a dozen or so of our allies in Europe, the Americas, and Asia. In the beginning each satellite weighs two hundred and twenty million pounds, contains twenty square miles of photovoltaic "blankets," and produces five gigawatts of electricity by the time it reaches the utility grids of Earth. (A gigawatt is one billion watts or one million kilowatts. For comparison purposes five gigawatts is just under the six-point-eight-gigawatt capacity of the entire Greater Houston area; all of the Tennessee Valley Authority generates about fifteen gigawatts of electricity.)

The satellites are injected into two low orbital belts, providing power to all nations on Earth that subscribe. By 1990, the international consortium of nations has thirty-five satellites in each of two belts and sells three hun-

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dred and fifty gigawatts of power to its own members and others. Over the next decade, more satellites are launched -and more efficient solar cells are developed and installed on the old satellites by second- or third-generation heavy space shuttles. Total capacity enlarges to fifteen hundred gigawatts. The United States as the major space power in the consortium derives income from the launches to offset part of its considerable outlay; U S corporations profit by manufacturing many of the components.

Result. By the year 2000 (the less optimistic may substitute the year 2030), powersats are sufficient to supply the total fifteen hundred gigawatt U S electrical need, which is some eighteen percent of total U.S. energy demand - up from about eleven percent in 1977. One-third of the powersat output is so deployed. The other two-thirds is consumed by the other consortium nations and other subscribers, which now vie to participate. Electric cars begin to be built on a massive scale as electric storage technology is spurred by the new age of ample electricity. The percentage of energy delivered as electricity begins to multiply dramatically and the barbaric burning of fossil fuels declines. Each barrel of oil now replaced by powersat electricity is two barrels of oil saved for the ten thousand petrochemical uses petroleum so uniquely possesses. (The making of electricity from fossil fuel is a wasteful conversion, let alone a smoky one. In 1977 a quarter of all raw fuel consumed in the U.S. resulted in less than half that fraction of energy delivered to customers.) Our trading partners expand their national productive capacities along with the U.S. Underdeveloped nations that subscribe to the global powersat system become more developed as plentiful energy spearheads a rise in the world standard of living. And now, on the foundation of powersat space stations in place, capacity can be augmented at the rate of a hundred gigawatts a year in the twenty-first century. An eventual "all-electric world" appears attainable as energy growth contributes to higher living standards that contribute to population stabilization. . . .

Scenario B obviously promotes peace (and plenty) over scenario A. Admittedly it is an optimistic outcome, and of course there are many other possible futures between these two extremes. The point of the exercise is to illustrate that cost of a new technology cannot be isolated but is interdependent upon many other economic, biological, political, and social phenomena. Cost is not total cost, and cheapest rarely means least expensive.

I have not included ground-based solar photovoltaic energy as a viable alternative, although it certainly may play a role in prototype-scale and regional power in many locations. Its projected direct cost is about the same as orbital energy without the economic and social advantages of becoming an international force toward peace. Another cost consideration deserves

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mention when comparing power satellites with any ground-based system. Orbiting solar plants have a tremendous advantage in being capital-expensive and maintenance-cheap: that is, in the hard vacuum of even low-orbit space where wind and weather are totally absent and the only degradation of materials possible is that caused by solar radiation itself, powersats will last much longer than ground-based plants. If a ground plant may be expected to last thirty years, then an orbital plant may last three hundred years! The only major portions of the plant that need be replaced will be the solar cells themselves. Under the assumptions described in the thought experiment, a vast replacement market will exist for at least seventy satellites times twenty square miles each, or fourteen hundred square miles of solar arrays in space. Billions of photovoltaic cells (or square feet of thermal films) will be involved. Working under a profit stimulus of that magnitude, periodic technical advances may be forecast with reasonable assurance. Thus the major component that can wear out will be replaced periodically anyway—and replaced at much higher outputs per dollar, which is to say at less cost than not replacing it. If powersats truly possess ultralong lifetimes in the vacuum of space, the amortized unit cost of solar electricity *must* be less expensive than any ground-based power plant.

Only a short time ago, communications satellites were thought to be too expensive too, compared with undersea cables. In 1977 we have almost one hundred comsats launched or planned—not because proponents won the original argument but because the bulk of the cost (which then was the building of our entire launch capability) was funded on another premise: landing men on the Moon to show up the Russians. Today, as more and more communications channels are required, comsats have become *the economical alternative* to undersea cables. Indeed the history of technology is one of a new development first entering a market, second dominating it, and third *creating* an entirely new market and way of life. Semiconductors, computers, and electrostatic photocopying leap to mind. How could we possibly exist today without "Xeroxing" our reports or our piano lessons? I have no doubt that powersats will create a new level of cheap global energy usage, so much so that one day our descendants will look back upon this era of energy indecision and wonder why such an obvious choice was so difficult. The only valid question is "when?" Solar energy from powersats is inexhaustible. It can't spill, explode, contaminate, irradiate, strip the ground cover, or pollute.

If we are not careful how we go about it, however, it can bankrupt us. Thus we must implement these—and other—energy concepts with the tool originally described, the International Decade of Energy Alternatives. Achieving energy independence for the participating nations should be

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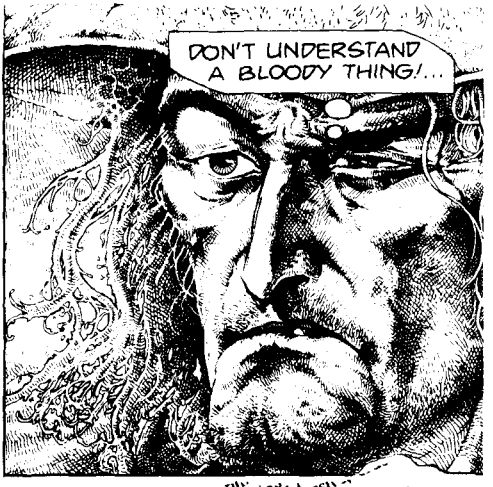

unusually tough, as in *heavy duty*. 2) heavy or clumsy in walking, **heavy-footed**, *adj.*, heavy or clumsy. **heavy-handed**, *adj.*, 1) clumsy, tactless. 2) oppressive, tyrannical. **heavy metal**, *n.* 1) a metal of high specific gravity. 2) gun or shot of large size, hence fig., ability, mental or bodily, power, influence, as "he is a man of *heavy metal*." 3) music that is predominantly brass or electronically produced, loud rock music with strong, sensuous rhythms. 4) from the French *Metal Hurlant*, lit., screaming metal, a magnificent new magazine with emphasis on brilliant and unusual science fiction/fantasy art, bizarre stories, etc. **racket**, *n.* (Slang), a branch of crime that involves or may involve personal violence. ... compound like water, composed of oxygen and ... of atomic weight 2, water enriched ... studies and as a moderator in ...

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geared to a rigorous time frame such as (with the years 1981-1990 as the IDEA):

1978–1980: Feasibility studies on all alternative energy sources. Negotiations with potential participants.

1981–1985: Selection of main and subsidiary sources. Determination of phasing technologies. Research and development funded. Treaties written and approved. Negotiations with oil exporters based on forthcoming powersats.

1986–1990: Design of all systems, installation of prototypes.

1991–1995: Manufacture and installation.

1996–2000: Expansion to significant scale.

The strong possibility that breakthroughs will occur in the harnessing of thermonuclear power or other sources need not change the initial focus on the technologies selected during the IDEA. Scientific breakthroughs in fusion or other processes will take decades to become meaningful contributors to global energy sources. When they do, the worldwide energy requirement (or the desire to explore space) will be so great that all additions to our present heavy reliance on petroleum and future use of solar, coal, and fission power sources will be welcome.

Even now a list of technical goals can be compiled for the IDEA. If powersats are chosen during the early years of the international decade as the primary focus, for example, an intensive multinational effort would ensue to increase solar cell performance, cost, and weight; demonstrate high-efficiency microwave power transmission; assemble structures in orbit because prefab powersats are too big to be launched; and begin a new generation of space shuttles, or heavy-lift launch vehicles perhaps driven by ion engines, so that only a hundred or so flights will be required to assemble each five-gigawatt satellite. It will befall the IDEA planners and engineers the task of advancing energy technology while diminishing the human problems associated with former power systems. The new energy must reduce chances for environmental disruption or illness, sabotage or terrorism, diversion of fissionable material to weapons, and catastrophic accidents. Orbiting solar power stations can accomplish these objectives, and if they are built their use will spread to other nonenergy pursuits as well. Manufacturing in weightless orbit where perfect spheres are formed in metals and in extreme vacuum where semiconductors can be processed by the billion for our myriad solar cells, astronomical studies from beyond our dense atmosphere, biological experiments in high radiation and the apparent lack of gravity—even tourism under the majestic blue Earth spinning in black space-station sky—can grow out of the concept, and contribute further to the poverty-free economy that the powersats will begin to make possible.

The timing of technologies is fortunate. Just as birth-control technology arrived in time to present an alterna-

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tive to overpopulation, the space shuttle, which will fly in 1980, is emerging as the first tool to build powersats in space. Other technologies also are merging toward the starting date. To reduce the weight of the enormous payloads required to build giant power satellites, thin solar cells only microns thick, made of crystalline or amorphous silicon, gallium arsenide, or other semiconductor materials, are emerging from laboratories at Solarex Corp., Spectrolab Inc., Varian Associates, and the University of Dundee in England, to mention only a few.

The beneficial impact of a global energy system on society is overwhelming. Only a century ago human

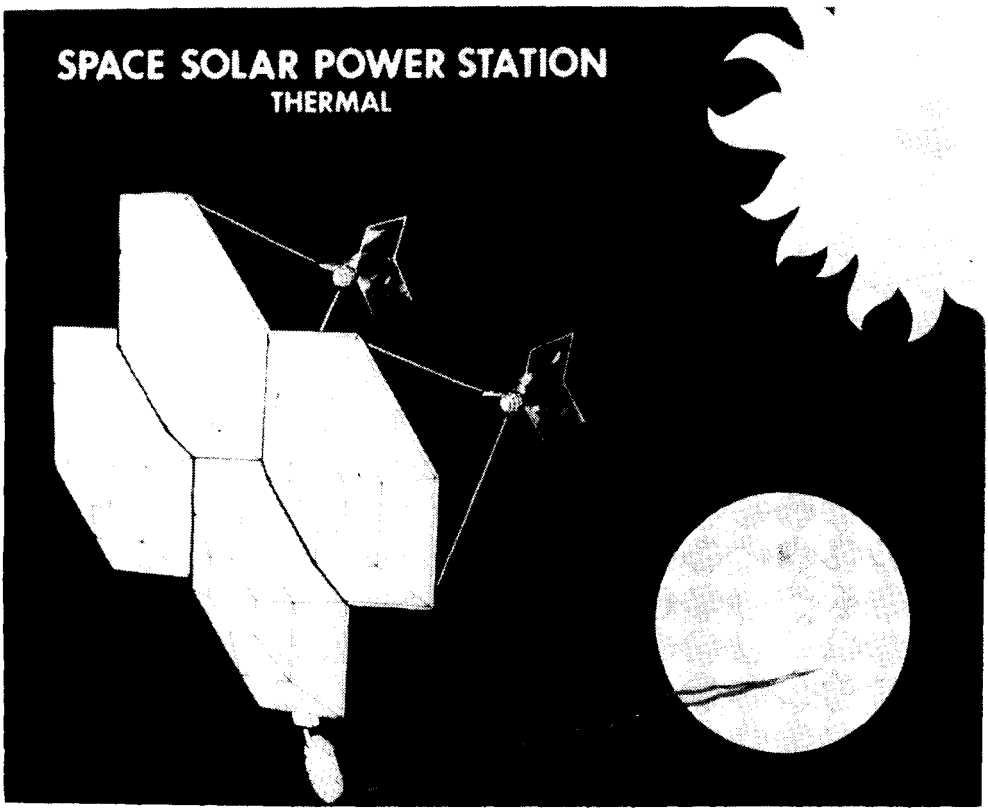

Figure 2: Thermal Space Solar Power Station, generating electricity from solar heat and transmitting energy to Earth by way of microwave radio beam. This particular design might generate about 14,000 Megawatts of power, with about 8,000 Megawatts available at the busbars after transmission. ***NASA***

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and animal muscle accounted for ninety percent of the energy used in U.S. industry. Today they supply less than one percent. Less-developed nations strive for similar consequential trends. Abundant and ultimately cheap energy through U.S. leadership for all peaceful nations would be the most dramatic example of good intentions that this country has ever exhibited. International powersats supplying mankind's most necessary commodity would be the proselyting triumph that the Apollo Moon missions were supposed to have been. Apollo *was* an engineering and scientific triumph, but it did not become a stimulus for all nations. This time we have the opportunity to provide a financial stimulus, and one of enormous magnitude, instead of a look-what-we-can-do boast. Industrial internationalization is in itself a force for peace. Would the Japanese have bombed Hawaii in 1941 had they owned a significant portion of industry there? While the location of the superindustry proposed for powersats is in space, the only feasible launch site is in the United States. More important, plentiful power should foster the growth of democratic governments because it is translatable into greater personal freedom and a higher educational level.

"Manhattan-style" crash programs may be out of favor just now, but the rewards in this case seem to justify that kind of giant technological effort, especially if done through the international milieu of ten years of energy achievement. The International Decade of Energy Alternatives is important to the orderly, economical development of any global power system. The combined resources of many nations contributing to the research, design, manufacturing, and funding of powersats—or any of the other energy alternatives—will amount to "a financial equivalent of war," which is always more productive than a "moral equivalent." If we actually could harness the giant-scale human, material, and financial expenditures of a world war for a world onslaught on the energy shortage, the benefits would expand and endure throughout the ages. ■

Neil P. Ruzic, a scientist-entrepreneur, has been suggesting ways of utilizing space since before the first sputnik roared its way into history. He holds the first U.S. patent for a device to be used exclusively on the Moon—a lunar cryostat—and has written seven books on the applications of science to social needs, among them three books on space: THE CASE FOR GOING TO THE MOON (Putnam 1965); WHERE THE WINDS SLEEP (Doubleday 1970 and a Literary Guild selection); and SPINOFF 1976 (NASA 1976). Ruzic is an executive committee member of the National Space Institute, which he helped form with Wernher von Braun. He also is a technology utilization consultant to NASA and developer of the Island for Science in the Bahamas. Ruzic is the founder of *Industrial Research, Oceanology International,* and other scientific magazines.

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art thou mathematics

Mathematics does not necessarily deal with the real world.
CHARLES MOBBS

"You understand that this is not a court of law; these hearings are conducted solely for the purpose of allowing us to decide if relevant legislation should be passed, and if so, what kind. Do you completely understand our purposes here?"

"Yes, I believe so."

"Well then, why don't you just start at the beginning? Please relate how you first became aware of the peculiar circumstances under discussion."

"It was May 13, Sunday, as I recall. I woke up that morning with a slight headache, as if some sort of pressure were being exerted in my head. Little did I realize how apt that thought was!"

"I'm sure."

"Well the headache was bothering me, but I tried to ignore it. After taking care of the menial tasks the day required, I decided to try to get some work done. Most people don't realize it, but actually professors of mathematics are required to do far more than teach . . . or even profess, if you see what I mean."

"I'm not sure I do. But please continue."

"Yes. As I was saying, as a professor of mathematics I must not only teach, but I am also expected to do original research. It's not the teaching I mind; I rather enjoy it. I don't really

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even mind doing the research. Both occupations are rather enjoyable, in fact. Now that I think about it, I derive a great deal of enjoyment from both . . ."

"You were about to make a point?"

"Quite. At any rate, I decided to work on a little piece of formalism I had been constructing which was related to the transcendence of a number known as gamma. I was trying to use a method analogous to Kummer's use of ideals to construct the set of all possible equations to which gamma could be a solution; then I needed only to prove that these equations were not algebraic, using a technique similar to Abel's and I would be done. But I'm sure you would not be interested in the details."

"Your perception is remarkable."

"The night before, you see, I had thought of a rather interesting approach. However, as I sat down at my desk, I could remember quite clearly the idea I had in mind the night before. This I found quite disturbing."

"Why was that?"

"The problem was that although I could remember it quite clearly, as far as I could tell, the idea was absolutely useless. It was rather unsettling."

"I can appreciate that."

"Well you may appreciate that but I can assure you that I did not. After trying unsuccessfully for several hours to regain my lost insight, I decided to read the current issue of the American Mathematical Society monthly journal, in the hopes of clearing my mind. I found that I had no difficulty in following the arguments presented there, but I still found it impossible to progress with my own problem. Up to a point, you see, I could completely understand where I needed to go with the problem, but past that point I could not concentrate, and my mind would simply not function. I attributed the difficulty to overwork and spent the rest of the day cutting out Mobius strips of various sizes and shapes, and trying to construct a Klein's bottle of Play-Doh."

"So what happened the following day?"

"I went to the university the next day as usual. I had decided to postpone work on my little project for a while, as my headache had not yet diminished. Things went rather smoothly until during my class that morning a student asked me a question about a rather trivial derivation. I was about to snap an answer when I realized that I did not *know* the answer to his question. Now it is not entirely unusual for me not to be totally familiar with all the subtleties of a given lecture, primarily because I have found that I can usually derive the answer to any question to which I do not immediately see the solution. The lecture appears thoroughly prepared and well considered, even though I may not have spent many hours before preparing it."

"No doubt."

"This time, however, I was quite at a loss to explain the assumption in question. The haziness in my mind

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irritated me so much that I snapped back, somewhat untruthfully, 'This assumption cannot be fully explained without extensive reference to the differential metric spaces associated with the eigenfunctions expanded around Z-6. Are you familiar with these concepts?' When he admitted that he wasn't I merely sniffed and finished the lecture. I later felt rather bad about that."

"Why was that?"

"I should have said the eigenfunctions were expanded about the Lagrangian. Sounds more plausible."

"Please continue."

"At lunch that day I related the experiences of my last twenty-four hours to a good friend and colleague who regrettably was not in a position to understand the true import of my predicament, being an applied mathematician. Don't misunderstand me; some of my best friends are applied mathematicians. Why, I even live next door to an engineer. So I'm no elitist or any such thing, though I wouldn't want my son to marry one. But of course such people cannot truly understand the difficulties involved when one tries to comprehend reality with the naked intellect."

"I wouldn't know."

"I suppose not. Well, I was relating my difficulties to my colleague and was elaborating upon Kummer's use of ideals on the rational numbers. 'Slow down,' he told me. 'You know groups are not my field.' Uh, I suppose I should explain that, well you see, the word 'field' he used as, well it was, I'm sorry to say, a pun, *un bon mot*, as the French call it. I'm afraid he still doesn't understand that his favorite device is, as Shakespeare would say, the lowest form of humor. I ignored his feeble attempt at levity, and proceeded on. However, just as I was really getting involved in my argument about the obvious transcendence of gamma, admittedly somewhat vilifying my critics, he suddenly grabbed my arm, looked me in the eye and said sternly, 'Let's not get irrational!' Again, I tell you the man was absolutely indefatigable."

"Evidently."

"After some struggle he contained me and convinced me to continue. As I related to him the classroom incident, he became very quiet, and my failure to properly construct the Play-Doh Klein's bottle elicited a positively grim reaction. He told me in a subdued voice that he too had had similar problems, though I scarcely supposed of the same import, and indeed he felt that the difficulty might be far more widespread than I imagined. 'The difficulty might be far more widespread than you imagined,' he said, and added gravely, 'It could be the death of organized mathematical inquiry as we know it today.' Oh, my God! Did I just say he added *gravely*? He's finally getting to me! I'm . . ."

"Get a grip on yourself man!"

"Oh! Sorry, I . . . it's just the shock. I'll be better in a moment . . . there. I can go on."

"You're sure?"

"Yes. As I was saying, I was of the

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opinion that my friend was overreacting violently to my story, and told him so. 'Look,' he said, and I blinked. He continued. 'I don't know what this is all about, but it clearly has to do with some cataclysmic force operating on our reasoning faculties. I can think of no way to properly approach the problem, but I have an acquaintance who often theorizes about the nature of such mental processes. Perhaps we should talk to him, except you may be hesitant because . . . well, he's an artist.' I exploded, 'An artist! My dear God! We'll be going to faith healers next! Look, if you can't talk about this rationally, I'll have to leave; and furthermore if you mention one word of this to anyone, the entire applied math department will know about your secret cache of number theory books!' I knew I had struck home there, as he turned pale as milk. I walked out of the cafeteria, visibly agitated.

"Well, things continued to deteriorate. My mathematical creativity was completely gone. I could scarcely do the most simple integrals without intense concentration. A plethora of arithmetical errors began to appear everywhere. I lost count while counting sheep. But what finally pushed me to the limit, as we say in the business, was the fact that the A.M.S. journal was not published the next month due to the lack of submission of papers; why, no papers were even bonded. I felt that the time for desperate measures had come."

"You felt obligated to do something yourself?"

"Yes, sir, most emphatically. We mathematicians must be in union or we most assuredly will be conjugated in intersection. That's a little trade joke there."

"I agree."

"Hmmmmph. Anyway, I called my friend and agreed to talk to his friend, the . . . artist. This decision was quite painful and arrived upon through careful deliberation, but it was clear to me that the entire mathematical world was being horribly affected. We mathematicians must be in union . . ."

"We remember."

"Yes. So we went to the artist's place of residence, going in the back way of course. I remember being rather warm, probably due to the trench coat and storm hat; the sunglasses prevented me from seeing the exterior details too well, especially since it was night. But at last we entered his receiving room and he was standing over in the corner, talking to his plants. 'Funny,' I whispered, 'he doesn't look artish.' My friend looked annoyed. He addressed the man by a name that sounded like 'choice posterior' and introduced me. The man grinned strangely and said in a whiny little voice, 'I understand you have a problem.' I had this peculiar urge to throttle him. However, I contained myself and in the most congenial manner I could muster I related to him all the events relating to the problem. He looked quiet for a moment and then began by asking a few questions.

"First he asked me a rather surprising question. He wanted to know how

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mathematics measured its own metaphysical limits. Though I don't suppose he really knew what he was asking, it was still an interesting question in that it dealt with a rather esoteric branch of mathematics known as transfinite analysis, for the obvious reason that it analyzes the size of infinity, or actually, the infinities. I explained

"'Although laymen usually think of infinity as a sort of incomprehensible void limitless by default, it is possible to understand the fine aspects of infinity much better by using the abstract concepts of class manipulation invented by George Cantor. What Cantor showed was that there actually exists a class of infinities, or a class of infinite classes, and each infinite class is of course limitless. Nevertheless, through brilliant and insightful analysis he showed that these infinities must be regarded as having different sizes, even though none of them has a finite size. For example, he showed that the smallest infinity, which he called Aleph Null, was the infinity which was the size of the cardinality, or number, of whole numbers, and also the size of the cardinality of all possible fractions. Now it may not surprise you that the number of fractions and the number of whole numbers is the same, since they are both infinity. However Cantor next proved that the number of *all* numbers, including fractions and irrational numbers like pi, also the cardinality of points on a line, this number is *greater* than the cardinality of fractions or whole numbers. He called [illegible] C, and according to the continuum hypothesis, C is the smallest infinity next to Aleph Null; this second smallest infinity is Aleph One. We now know that there is an even larger infinity: the total number of all possible curves. Since every curve can be represented by a mathematical formula, this also represents the total number of functions in the mathematical world. It also represents the number of points in an infinite dimensional space. Since every infinite series can be represented by some sort of mathematical function, it is seen that this third smallest infinity must contain them all, as well as the first two infinities. Thus even though there are theoretically an infinite number of infinities, virtually all of mathematics is done in the smallest three.'

"The artist looked as if he were smoldering over a fine charcoal broiler. I had the impression he was on to something. As if reluctantly picking an uninvited insect from his cherry cola, he asked, 'And what, may I ask, is an infinite series?' I felt that he knew, but did not want to believe it. So I explained.

"'An infinite series is the representation of the sum of an infinite number of terms, the progression of which is determined by some sort of formula. For example, $\frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \ldots$ and so on. We set up these series in order to determine various facts about the functions they represent, since often the sum is a finite number even though there are an infinite number of

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things being added. If the sum is finite, the series converges; otherwise, it diverges.'

"The artist looked angry for some reason, but was evidently restraining himself. He visibly forced himself to ask, in a too quiet voice, 'The mathematical community did not accept Cantor's concepts for a long time after he proposed them, did it?" Somewhat startled at his perspicacity, I admitted that it wasn't until shortly before Cantor's death that mathematicians generally agreed that Cantor was right about transfinite classes.

"He seemed about to say something, then as if grabbing at proverbial straws, asked one last question. 'In which infinity would you say the cardinality of mathematical facts belongs?' I was again deeply impressed, because once more he touched on a truly esoteric topic. For an artist, he was extremely perceptive. I amiably responded, 'That is really impossible to tell. For you see, a man named Kurt Godel proved that there are an infinite number of true mathematical facts which cannot be proved. Not knowing the extent of these facts, it is impossible to tell the theoretical number of true facts, besides the number of provable facts.'

"This, evidently, was too much for him. The artist seemed outraged. He made the following explanation:

" 'I believe I now understand the nature of your problem, and if so, I can only say you richly deserve your predicament. You mathematicians have made a universe, and all you do is explore it. You make a cave in which to play and have filled it with water so that when you have filled it with water you will know how big it is. It has been fun while you have filled the cave, to watch the oscillating waves, the varying rates of flow, and so on, but when the cave is full you no longer have a place to play.

" 'We artists create new universes all of the time. We artists prefer to create universes of subjective, emotional, or communicative content. It becomes tedious and boring to explore a single universe to abstraction.

" 'My own theory, to which if I were you I would assign a very high probability of accuracy, is that those monsters you call infinite series are to blame. You have created a conceptual entity whose sole possibility for a meaningful existence is to expand to infinity. What a cruel way to conceive of and nurture any entity! From the moment series were conceived, each one immediately began to attempt to achieve its existential sense of being, but you mathematicians had, through an incredible blunder, made this impossible: they could be conceived in Aleph Null, but could only completely exist in Aleph One or Two. Cantor nearly corrected the problem before it was too late, but probably due to the stubbornness of mathematicians worldwide he did not quite succeed. Through an effort of sheer will, Cantor expanded your mathematical universe to accommodate an infinity of infinities: a labyrinth of caves, if you will. This not only prolonged the

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pleasures mathematicians could derive from the quickly depleting system, but also made more room to accommodate the quickly expanding conceptual entities. Unfortunately, Cantor's sheer genius was blocked by obstinate opposition, and he finally settled on what turned out to be an unsatisfactory compromise. He created the infinities, but allowed that the great bulk of exploring had to be done in the smallest three infinities. Unfortunately, the infinite series functions were expanding to fill the largest, and thus the other two by default. Cantor's fault, I'd say. Clearly this situation would be fatal, and we know the result: the mathematical universe no longer has room for any new creative explorations because it is nearly completely full of expanded series; soon there will no longer be room for any sort of new mathematical knowledge whatsoever, which means only previously calculated problems will be solvable, by either computers or by man.

"'I could probably create a new and better universe for you to modify, but I am not inspired to do so. Your present universe was so warped by Godel's monstrous perversity, which he also imposed by sheer effort of will, that I am not sure I would be willing to have art of my own risk being thus distorted. Furthermore, I would not care to create a universe so dull and cold as the one which your own earlier artists, Aristotle, Euclid, and Pythagoras, had forged, and which you logicians have finished. I am sorry.'

"I could not believe what I was

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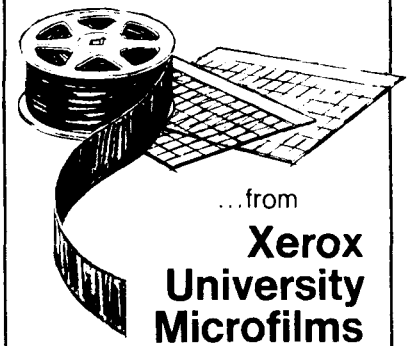

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hearing! 'This is incredible,' I said. 'You speak of series as incomplete entities, but they are only a method of arriving at certain conceptions. You clearly do not understand the nature of Cantor's and Godel's work, that they discovered underlying facts about our universe from a previously existing structure; they did not make that structure. It is useless to talk to you in your abysmal ignorance.' I liked that phrase."

"I would assume so."

"Well, he got rather annoyed, I'm afraid. 'It is pitiful to watch your feeble attempts to rationalize the efforts of your greatest geniuses by a prohibitively confined and incorrect perception. Just one test: can you think about the continuum hypothesis with reference to Aleph Two?'

"I suddenly realized that he was right, but I could scarcely let him know that. 'I knew you could do nothing. Useless beggars!' I strode toward the door, and just as I was leaving I shouted, 'Michelangelo was an iconolagniast, anyway. A plague on you and everyone who looks like you!' I was overcome with passion."

"Evidently."

"Anyway, the world seemed to carry on fairly well for a few days, in spite of the total loss of creative mathematics. This I found to be the most depressing aspect of the entire affair. Soon, however, just as the artist predicted, only the simplest arithmetic calculations were possible, and our entire accounting system began to break down. My headaches were reducing me to a Bayer existence. Then one morning I woke up and suddenly the haze was gone! I had several new insights: Fermat's last theorem was trivially simple to prove, and even more important the flaw in Godel's theorem was obvious. I decided to inform my artistic friend of his dispensability. Arriving at his flat, I said sharply, 'I told you your idea was stupid. It was only a temporary condition. Probably in the atmosphere, ozone maybe. Anyway, I can think better now than ever.'

" 'Of course it's better,' he replied. 'I made it, did I not?'

" 'What do you mean?' But I knew.

" 'You don't believe me? Surely you realize that if I were to correct it I would make Godel's theorem invalid?'

"My worst and most horrible fears were confirmed. I was a broken man. 'But how did you do it? And why?'

" 'Well, you gave me enough information to allow me to create a proper universe. And of course a true artist like myself is not put off by tasks of Herculean proportions.'

" 'But why?'

"He looked rather embarrassed. 'Well, for the fifth time this week I got a computerized bill with an error; and even worse, I haven't been able to balance my checkbook in over six months.'

"I hadn't the heart to tell him that the problem had only begun two months ago. Artists are a rather temperamental lot, you know." ■

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clichéland

"We've got to get to S Doradus before the cataclysm destroys our entire colony there!" shouted the hero.

"Sorry," said the physicist, "but even if we travel almost as fast as light, it will still take us many centuries of objective time to get there. You see, although relativistic effects can . . ."

"Stuff it!" snapped the hero. He grabbed the starship's throttle and rammed it to the firewall. The gallant ship shuddered, then leaped ahead through the star-studded void.

"You can't go faster than light," the physicist insisted.

"How do you know? Have you ever tried?"

"Of course not. Even if you were able to go exactly as fast as light, I wouldn't advise it."

But the hero was busy activating the ship's Docsmith coils, which absorbed energy from the surrounding cosmos and poured it into the propulsion units. The stars became smudges, then rainbow-colored streaks.

"But it won't work," the physicist muttered. "As the ship goes faster it gains mass (when it's moving at nearly the speed of light). The more energy you pour into it, the more mass it gains. The more massive it becomes, the more energy you need to make it go faster."

"The hell you say," the hero shouted exultantly. "Look! We're almost at lightspeed already. We'll get there yet!"

But the physicist shook his head. "I hate to tell you, but if we get to the speed of light, our mass becomes infinite, which means we'll need an infinite amount of energy to accelerate us any further."

"The coils will pull in all the energy we need."

"But if they do . . ."

Too late. The ship hit lightspeed and absorbed all the energy available in the universe. It all collapsed into a relatively tiny cosmic egg.

Moral: It's not true that no object in this universe can go as fast as light. One object can. One per universe.

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Swanilda's Song

Operatic sopranos are supposed to stare face-to-face at death and never miss a note. But in real life? And on an alien planet?

FREDERIK POHL

In 1975, Harlan Ellison conducted a lecture series at UCLA under the general title of Ten Tuesdays down a Rabbit Hole. *The subject was science fiction. The participants, beside Harlan himself, included some of the best-known people in SF. And one of its features was the creation of a world: Medea.*

Like his well-known Predecessor, Harlan did not fiddle around with details. His function was pure creation. "Let there be Medea," said Harlan, and summoned up a corps of specialists to do the job. He charged Hal Clement with inventing the astronomy of the planet, complete with primary, sibling satellites and geological past. Poul Anderson worked out the meteorology and geography, and calculated the effects of the parameters Hal had decreed. Larry Niven peopled Medea with creatures to make it live, and Frederik Pohl devised societies and folkways for them to live in. Then Frederik Pohl, Tom Disch, Frank Herbert, Jack Williamson, Robert Silverberg, Kate Wilhelm, and Theodore Sturgeon made up Medea stories.

All of this is going to appear as a book entitled Medea: Harlan's World. *Meanwhile, here is Pohl's story. More will follow—soon. The Editor.*

Chapter One

My name is Swanilda Guthrie, and this is the story of how I saved Civilization As We Know It. Hold your applause, folks. It wasn't all that hard, not to mention that Civilization As We Know It may not really be all that worth saving.

But I did it. At no small cost to my safety. And my skin.

You might wonder what a nice soprano like me was doing in a situation like that. It was simple, really. I needed to juice up the act, because things hadn't been going right for me. That was a condition with a considerable precedent in my life, all the way back to the time I made my debut. And that was at the age of twelve and a half, in St. Rose of Lima Convent School in Grand Rapids, Michigan, which by coincidence was the exact age, and even the exact day, at which I attained the elevated state of mature and fertile womanhood. Bad scene. An hour before I went on stage I was wrapped in a blanket in the principal's office, with her desk calculator on my stomach, crying my eyes out. I don't know what good I thought the weight would do. It didn't do any good at all. I hurt. I went on hurting all through the Christmas production of *Hansel and Gretel*. This particular story has kind of a happy ending because, to tell you

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the truth, I was a smash. But to tell you the rest of the truth, with my guts feeling as though somebody was poking around in them with a soldering iron, I didn't care.

So at twelve and a half I was a sensation, with notices in even the Detroit and Chicago papers. At thirty, not so much of a sensation. The fellow I happened to be married to at that time said he sometimes thought my first name was "And," because all the reviews said, "The cast also included This One, That One And Swanilda Guthrie." and later still, at—well, let's not be too despicably mathematical about this. At a certain period some years later, and also some half-million cigarettes, maybe a thousand liters of booze and two or three husbands later, when my agent, Stan, told me I had to make a move, my biggest moments had come down to song recitals on college dates at places like State College, Pennsylvania, and Permian Basin, Texas.

It isn't fair, you know. The voice didn't change. Just the rest of me changed. I think I would have had some great career if I had been able to keep on singing Hansel forever, because I was a knockout in the pants parts. I almost sang *Fledermaus* at La Scala once. I would have made it, too, except that right about then was when I began to like to eat. A soprano who is a knockout when she weighs fifty kilos stops looking cute dressed up as a boy when she hits seventy. I couldn't even sing Mimi any more. *Boheme* has that bit in the second act where the Rodolfo is supposed to pick me up and carry me off stage. The last time I tried it, in Denver, he dropped me twice in rehearsal. So we worked it out that I would sort of lean on him and we would stagger across the stage together like any taxpayer lugging his drunken wife home to the two AM screaming match. But the audience, God damn their hearts, laughed.

Well, that's what happens. There were still parts I could sing. But I never had that deep, raw voice for the Queen of the Night or any of that stuff, not to mention that it's a long time since I had the build to crouch down behind the scenery for forty-five minutes and then burst out with that full-voice scream. And when you come right down to it, Swanilda, face the facts, you never had those Beverly Sills or Monsarrat-Cabale lungs. A small hall I could fill very nicely. Even truly. But to wake up the college kids in the top balcony at the Met, no, not me, not without screeching.

So when Stan gave me his quarterly excuses for the fact that my next season wasn't going to be exactly a triumph, I wasn't surprised. But then he said, "Swanilda, honey, I want you to hear something."

"Don't you mean you want to show me something, Stan? Like back in your dressing room?"

"No, Swanilda, this is serious. I got a telegram from State College, they don't want you back this year."

"So? There's plenty more like that!"

"Well, no, Swanilda, there aren't.

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Have you ever heard of Medea?"

"Sure, but it's out of my range, Stan."

"Not the part. The planet."

"Oh. Oh, certainly. There was a TV special on it a while ago."

"They have these creatures that sing there. Let me play you some tapes."

And he did, and while I listened I was trying to remember about this Medea. It had semi-intelligent inhabitants. One kind that looked a little bit like spaniels, another kind that looked sort of like jellyfish. Except that they were full of hydrogen, and they floated in the air.

And—yes, they sang. I hadn't really had any idea how *much* they sang until I listened to Stan's tapes. There seemed to be dozen or more of them, all singing at once, not exactly in parts but doubling each other and then sometimes doing very peculiar harmonies and counterpoints, a little like Alban Berg or early Stravinsky. It grew on you if you listened.

Stan snapped off the tape and said, "What do you think?"

"It's very *Wozzeck*, Stan. I don't know if I could sing it."

"I don't want you to sing it, honey. I want you to become a musicologist specializing in it. There's a government grant to send somebody out there, and I'm recommending you."

"Musicologist! That's for some has-been, Stan, not for somebody in the middle of a performing career."

He reached out and took my hand, and for the first time since I'd known him Stan looked at me not as though I were a percentage or a quickie in the back room, but a living human being.

"Honey," he said, "That's what I've been trying to tell you. You don't have a career any more."

So I thought it over carefully, and I accepted. It wasn't hard. Stan was telling me true.

Sixty-one years out and sixty-one years back! That was the hard part to get used to. Of course, I wouldn't age a hundred and a quarter years. I wouldn't age at all, or so they promised me. (They didn't tell me what the liquid nitrogen would do to my skin.) And they gave me a contract, officially signed on behalf of the U.S.I.S. of the State Department of the United States of America. Is a contract any good when the person who signs it has been dead a hundred years? I didn't know. But I was willing to take a chance on finding out, because it promised me a tour with my Medean songs, and it mentioned places like l'Opera and Albert Hall and the Bolshoi. Those are places I had been in before, all right. But never, dear friends, without buying a ticket.

So there I was, on the way to Medea, and Stan surely thirty years dead before I got there.

Born again to a new life!

How thrilling that sounds. How crummy the reality. When they tucked me into my little freezer bottle, ten days off Earth, the last thing I remembered was promising myself that I would take note of every last bit

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of what it felt like to come alive again in a new world. Well, what it felt like was lousy. Where my hair hadn't snapped off at the roots it was a smelly tangle. My skin was shedding. My eyes wouldn't focus; put me all together, and I was the worst looking soprano who ever slept her way into a part.

But that wasn't enough for Swanilda. There was more. I smelled, and so did the ship. It had that good old morning-after fug, as though mink had been breeding in it for years.

We were all being waked up at the same time, stumbling around and smelling bad and complaining. The human beings were bad enough. The little Medean creature they called a fux, looked like a sort of a stretched-out spaniel and had just finished getting a degree at Oxford—nice little pooch, I'd tousled his ears, or where his ears ought to be, before we sacked in—anyway, he had forgotten his housebreaking. He lay with his nose between his paws, whining sorrowfully. Oh, we were a jolly crew. But I wasn't really noticing all of that, because there was worse still.

See, what they don't tell you about cryosleep is how it hurts.

The run from Earth to Medea takes sixty-one years. You don't know the time is passing, because you're a liquid-gas corpsicle, frozen and uncaring. Well, that's cool—that's fine, I mean. But some parts of you freeze in ways unlike other parts of you. Nothing big. Nothing life-threatening. But if you happen to have been lazy about brushing, so that the Tooth Fairy got pissed at you and you grew up with a mouth full of dental findings, you wake up with the grandmother of all toothaches. Oh, Jesus, yes. The metal in the fillings contracts with the cold just a little faster than the tooth does. Not much. Just enough to pull away from the cement. So then you come to where you're going and you warm up again, and what happens? Nature abhors a vacuum. Gas has seeped in to fill those little spaces, and now the little pockets of gas are under pressure as the spaces close back. What do they press against? Why, tender old you, that's what they press against, the rawest, openest nerves in your jaw. So the way I woke up was, I woke up screaming in pain.

I wasn't the only one with a toothache. But old Swanilda's a pro at screaming and she can hit those back balconies when she doesn't have to worry about purity of tone. I was the one who got the first shot of novocaine and the first turn in the dentist's chair when Bill Garmer, the podiatrist on contract to one of the colonies who was the closest thing we had to a ship's medic, got his own head cleared up enough to try to help me out. With all the novocaine in the needle, it still hurt so much that he was nearly through before I noticed who he was. "Eh-oh, Ill," I said. My enunciation has always been a strong point. But not with a mouth full of fingers and drains.

Good old Bill didn't even give me a tumble.

That made it complete. Bill was a

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doctor, and therefore as permanently horny as a gonadal fux, and if he wasn't conscious of me as a sexual being I was in trouble.

Much chastened, I got out of the chair. Now that my jaw had stopped exploding I could think about my skin and hair, not to mention getting something to eat and smoke. A spaceship isn't much good for any of those things. There isn't room for your classy onyx tubs and marble shelves of skin cream. The best I could have was three minutes in a cylindrical tin shower.

Half a kilo of dead skin flakes went slurping down the drain, but I was still a long way from the thing of beauty I aimed at. At least I got out of the coveralls I had worn for sixty-one straight years in the feeezer, but what they gave me to replace them was an identical set, dropseat, booties and all. Captain-Pilot Bechmann wouldn't let me get at my own clothes in the storage compartments. Some nonsense about the vacuum of space. And five minutes out of the shower I needed a bath again. The oily, sweaty atmosphere of the ship, denser and hotter than I was used to soaked right into my pores.

The situation needed thought. With eight smelly men and an airsick pooch stumbling around I wanted to be by myself. The place with the least traffic was the navigation pod, and I hid out in it for a quick cigarette, but Harry Bechmann found me and rousted me out. "Jesus, Swanilda," he snarled, "you know you can't smoke here. Come out and give us a hand cleaning up."

"Sure thing, Harry," I said gamely. He was one of the two best-looking men on the ship, and we still had ten days before we landed.

So I was a perfect brick for Harry. I cleaned up puppy mess and I stowed castoff overalls. I played ministering angel for the poor sod of an agronomist whose gout had been touched off in the freezer. I helped Harry try to zero in on the landing signals, and sympathized with him when he couldn't get a clear fix. Then I began to feel pretty rocky myself. And I realized that the old plumbing, out of action for sixty-one years, was trying to catch up. I was starting my period.

Some things never change.

Taken all in all, being reborn to a new life, considered as a sensory experience, was a total washout. It was about as smelly, messy and traumatic as being born the first time.

I thought longingly of Sexy Stan, my agent man, who got me into this. If only he were on the ship at that moment! First I would compliment him on his creative agentry. Then I would thank him for his concern for my welfare.

Then I would kill him.

By the time we were ready for penetration things had begun to sort themselves out. Medea was all fat and greasy-looking down below us, big red fried egg with a white yolk that Harry said was the heat pole. He still wasn't getting good signals: ambiguous read-

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ings from the RDF and no voice contact at all. But he locked in and told us to belt up for landing.

I can't say I was looking my best. My period had run its course, and Harry had relented enough to let me get into the storage compartment for one small bag—the risk of its losing pressure during the long flight had turned out to be a false alarm. Hot as the ship was, and bad as the food, I'd sweated off at least four or five kilos. That was all to the good. But my clothes didn't fit any more. I couldn't even take pleasure in counting each gram of the weight I had lost, because Harry kept changing the deceleration. One minute the scales would show me fatter than ever, and the next I'd hardly be there at all. Harry swore a lot while he was doing it, and the rest of us whispered to each other and wondered whether, if we had a better idea of what was going on, we would be scared witless. Whatever Ground Control was supposed to be doing, it wasn't doing it. Harry looked as though he was having his work cut out for him to get us down safely.

But he did. Not counting the last couple seconds of deceleration, when I felt as though I weighed a metric ton and the safety web dug creases into all the best parts of my flesh, it was a piece of cake. We were down on the surface of Medea.

"Stay put for a minute," Harry yelled over the creaking of the hot metal and the sloshing of fuel in the pipes. He did something at the controls, and a sudden shrill whistle told us that the pressure inside and out was being equalized. That took a while. The rest of us tried to stare out of the few tiny portholes to see what our new home looked like. At first glance, nothing. There was supposed to be a colony, three thousand people there and nearby, with sunstills and farms and even a couple of factories working. None of that appeared. There was an ocean, or maybe a very big lake. There was a lot of uninspiring flat landscape, and in the distance maybe some trees, or something like trees. And that was it.

"I don't think this is the right place," said Bill Garmer, and the little old fux whined forebodingly. But Harry clenched his teeth and opened the hatch and ordered us out; and one by one we stepped onto the surface of Medea.

What a place! I could see why they had run the ship so hot. If we had come right to Medea out of the deep freeze we all would have died of heatstroke, and even so it was a close thing. The place wasn't just hot. It *looked* hot. That ugly sun, or whatever it was, was the red of a fireplace coal, and everything we looked at took on that coloration, shades of scarlet, shades of rust, and the whole thing soggy wherever you touched.

We clustered together outside the lander, looking depressed or astonished or mad, according to our moods. Harry was the angriest: "—damn *lousy* landing procedures," he was muttering, "and where the hell *is* everybody?" We seemed to be out at the

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tail end of nowhere, flat rocky beach that stretched for kilometers along a greasy-looking lake. The old fux crept under my hand.

"They're coming, Harry," he whined, quivering with dismay. And so they were. Loping toward us were a pack of a dozen or more fuxes, nattering at each other and to us. Behind them, coming more slowly but still at a run, were half a dozen men and women. They looked particularly raunchy, even for this place, even at a distance. The closer they got the worse they looked. None of them had kept their appearances up, hair flying in all directions, the men with shaggy beards, their clothes sketchy and tattered.

What had I expected? A torchlight parade, a customs bureau, I don't know, but not this. Where were the great clouds of singing loons for me to tape and build a career on? Where the docile packs of fuxes tending the broad plantations, while the humans sipped their juleps and flirted in the shade? Oh, Stan, if only you weren't dead already, how gladly would I kill you for getting me into this!

The pack of fuxes circled around us, like hounds treeing a raccoon, growling at each other. My personal fux rubbed against me mournfully and then slunk away to join the others, turning and lolling his long maroon tongue out at us. "Traitor," I snapped, but he didn't even look at me.

Harry Bechmann took charge. To the people who came trotting up he said forcefully, "I want to know who's responsible for this foul-up, and I want measures taken to prevent a recurrence! Your downbeacon was on standby all the way. I never got a response to my clearance request. I had to navigate manually from low orbit to—"

"Shut up," panted the ugliest of the men, kicking a fux out of his way. He stared around at us, and even behind the ragged beard I could see his face fall. "Shit, only one woman," he muttered.

"Ms. Swanilda Guthrie, yes," said Harry. "I'm Harry Bechmann, commanding. This is my navigator—"

"I said shut up," snarled the man. "All of you. Keep quiet, line up and take your clothes off."

"Now, see here!" Harry began.

"Now," barked the bossman, reaching out for the nearest person to shove into line. The nearest person happened to be me.

Well, that was about all I could handle of that. They used to say that old Swanilda never really sang like a prima donna, but she sure had the temperament for it. I leaned forward with my handbag and slashed it across his face. "I'm Swanilda Guthrie!" I told him. "I've had more concert dates than you have hairs in your scrawny—than you can count! I'm a star, and I want to be treated like one!"

The nearest fux sprang toward me, looking like the kind of thing you find in jars in veterinary schools. "Shall I nip her Jim-person?" it whined.

The hairy man stood still, his hand to his chin where I'd caught him with

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the bag. "Not just yet, fux," he said thickly, rotating his jaw a couple of times. "When *he* comes *he'll* decide. I may get to tame this one myself."

The pilot had been staring, and now he cried: "You're Jimmy Cargle!"

The hairy man looked at him, and the pilot went on excitedly, "Sure, Jimmy! We were in stellar navigation together. You piloted the ship three years back!"

"Has it been three years?" Cargle said wonderingly. "Yeah. Maybe it has. But don't fool with me now, Harry, get your clothes off. All of you!" He snaked the whip he was carrying. "I know how you feel, all right? But I don't have time to talk about it now. Listen! They're coming, and if *he* gets here before you're ready it's my ass too!"

Harry sighed. "Do what he says," he advised, beginning to strip. That was no big deal. You do Salome a few times in one of those East Bay theaters and you stop worrying about being naked in public, but this was kind of weird. They weren't even looking at me! Over the whimpering of the fuxes I was hearing some other sound; it grew louder; by the time we were bare they were all down on their knees, or the human beings were, while the fuxes were crouched with their heads between their forepaws.

And the sounds were getting loud, and I recognized them. Almost. They were a lot, but not quite entirely, like the tapes Sam had played for me.

And over the top of the lander came half a dozen Halloween balloons, bobbing down out of the cloud. They were nearly two meters through, the first of them even bigger than that. But they weren't quite what I had expected, toy balloons looking no worse than your average Portuguese-man-o'war jellyfish. They were different. The terrible part of them was that along the bottom part of each, part of the balloon itself, like a ship's figurehead, was the outline of a sort of Picasso schematic bas-relief of a human body, and the bodies had faces, and they were all looking at us as they sang.

Chapter Two

I am the tenth and most successful of my line, Mark J, a credit to the industry and wisdom of my ancestors and their servants. When I sing the songs of the glory of my reign the whole flock joins in with joy, and the ruddy skies shake with our chorus, and even the forests resound to my majesty. But there is one song I do not sing, except in private.

It is a song of the time when I was newborn, and my nurse took me to have my future divined. A curious thing happened. The diviner was an old post-gonadal male, with that curious graying of the eyes that the servants develop shortly before they die. It is sung that their senses sharpen at that time, and that what they perceive is doubly certain because, being themselves so close to eternity, they are able to see through the veil. Well, if you will believe that you will believe anything. Still, it is curious, as I have said, and the evidence one way

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or another you may judge for yourself.

The diviner sniffed me all over very carefully. Then, he nibbled, very delicately, a tiny sample of tissue from what was left of my birth sac. "Careful, careful," my nurse whined, knowing what would happen to her if I were harmed. The diviner did not even reply. He rolled the crumb around in his mouth, and then he spoke in a clear high-pitched voice:

"Ingredients of Earth and ingredients of Air. This one is born to power."

My nurse sniffed. "Don't be an old fool," she said. She meant that all that was clear to begin with. Even if the diviner had not known who she was, and who the infant she carried was, both of which were unlikely, there would be no doubt that I was a human hybrid. In certain stretches of my gene pattern I retain clear traces of a male ancestor born in Clearwater Beach, Florida.

"You lack respect," the diviner said tepidly, his eyes glazing as he rolled the morsel over his tongue. "Yes, yes," he murmured. "Cytidine, uridine, adenosine—yes, thymidine. And there is guanosine. Now let us read the coding." The acuity of the servants in this respect is legendary, but they do like to take their time about it.

"Hurry," whined the nurse, glancing about fearfully. "If *he* finds us here—"

The diviner roused himself. "You destroy concentration," he complained. "Nevertheless, it is clear. He will live for virtue and die for vice, and he will rule the heavens. But he must beware of the heat of lust."

"Do you mean sex?" snapped my nurse. "All you old ones think about sex all the time."

"I mean lust," he said grayly, breathing in ragged gasps. "Pay me now, I will not live to enjoy it tomorrow." And so she gave him a shot of dreammaker, and he went off to sleep and never woke.

Now, you doubt all this, do you not? And yet I will astonish you; I will sing what you are thinking, even though you have not expressed it. It is: How can J-Mark know all these things, when he was just born when they occurred? Why does he sing of details that he could not possible remember?

But there I have you! For I said, did I not, that a curious thing happened. As we were leaving the diviner's hut there was a raid of my father's servant-police. My nurse was arrested for exposing me to contamination from the old fux. She was destroyed and fed to her own whelps but my new nurse, her sister, preserved the records. All that had happened was recorded on tape, and she played them to me when I was old enough to understand.

The curious thing is that what the diviner said has come true. Of my father's get there are many thousands, and at least forty as fully recombinant as I. But it is I who rule the heavens, and that I live for virtue is known to all who hear my song.

* * *

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In the fifteenth terran of my rule we received a replenishment from Earth.

It was not, of course, intended for us, but in accordance with my instructions the Earth-servants transmitted a homing signal to the replenishment vessel. At the same time certain of my own sibs swarmed toward major encampments of the Earth two-legs, carrying devices for use at such times. These had been devised by the wisest of my fuxes and constructed with great pains by Earth-servants skilled in these matters. When the two-leg encampments sang to the replenishment vessel to come, the devices learned the signal and retransmitted it out of phase, so that all the vessel heard of the welcoming song was a discordant squeal. Often the device did not work. Then the Earth encampments received a new shipload of colonists, and my servants received sufficient punishment to make them dislike failure. But when it did my followers increased.

All of this was done by rote as soon as a vessel was detected. I was with the swarm in high-flight, singing beautifully. But it has always been my custom to inspect the replenishment servants in person and at once, so with six of my nearest gene-sibs I left the swarm to perform this function.

As usual, the new servants arrived in deplorable state. The stink of the deep-freeze was still on them. My personal ground-servant had run to meet me there, with others of his pack. He was shocked and disgusted, but then he was newly post-gonadal and had never seen an arriving shipment before. "Lord," he said, "look how feeble they are! Can we not receive better specimens?"

My personal man-servant took this as an affront. "Foolish fux!" he cried. "We can't tell them what to send! Anyway, we'll fatten them up, lord."

"Not too fat," I cautioned. I was not angry. Nor was I trying to tell him his business; when you have a good stock-handler you let him do as he knows best to do. But you must show him that you are watching.

He cowered. "No, no, lord! Certainly, not too fat!"

I was at nearly neutral buoyancy, holding my ground-servant by the tail to keep from being blown about. "Closer," I murmured, and allowed him to bring me nearer to the new servants. There were eight males and only one female. Pity. I wanted more females for breeding. It is always good to introduce new bloodlines into the mix when you can get them. The untamed males made attempts to communicate with me in several languages, most of which I knew. However, I did not listen to the words. They might have been threatening. What you do not hear you need not punish, and there is no point in punishing untamed stock. It can damage them, and once they have been tamed it makes no difference anyway.

"They are not very big," I sang. My ground-servant had recovered his courage and smirked.

"Not like us, no, lord," he agreed. I pinched his tail to calm him. He

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yelped and was silent, properly terrified again. The new males were of course as yet unaltered. Even so, the size of their genitals would not impress a ground-servant. The penis of a rutty fux is nearly an eighth of his body length. Yet a fux is only a meter or so long. I exhaled and sank to the ground before them, catching at my fux's familiar fur to steady myself. "Takes you back to the old days, eh?" I observed kindly to him.

He laughed obediently, but a touch wistfully. His rutty time was only a few seasons behind him, and I could see that he still regretted it. "Do we need males for breeding?" I asked the man-servant.

"No, lord," he gasped. He was still out of breath from his run to meet me. He was replenishment stock himself, and not adapted to the muggy heat of Medea; also he was growing fat.

"Nevertheless," I sang, "I think we will keep these whole for the time being. One never knows when we may need a new breeder."

Quaking, "Yes, lord."

"But don't breed them yet."

"Not even the female?" He was still frightened, but not so frightened that he was not also disappointed. I could see who he had picked to breed the female with.

I did not answer, merely rotated to look at him carefully.

"Yes, lord," he said miserably. "No, lord. As you have sung, they are not to be bred. I will have them tamed at once."

But I was not through with him yet. "No, not even tamed," I sang. I had no particular reason for that, except to keep him in fear.

Unless what the diviner told my nurse was a reason. There was something about these replenishments which suggested an interesting kind of vice. I would be careful not to die of it, of course. But it would be exciting to come close. My glorious ancestors, before the interbreeding that produced me, used to play a game with the fuxes, bobbing low and close to them, defying them to leap high enough to catch them, while the fuxes went mad with frustration and appetite. They always won that game, of course, or else I would not have been here.

It is now an appropriate time for me to sing my name, titles and ancestry. I am Phosphodiesteraze Oliver Strong-Singer Two-Group Shackleton, Mark J. I am of mixed Earth and Medean blood, fully recombinant and true-breeding, as were both my parents before me. Of course, I am the flock-master. My flock is not primitive aboriginal balloonists; there are twenty other recombinants in the swarm, plus females and young. We sing Earth-English, and our songs have triumphed at every gen-chorus since I first became flockmaster. The sky of my flock includes all the transmontane currents surrounding the Purple Sea, and we own six herds of fuxes and two of Earth-humans, one used for draft purposes and food only, which is al-

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BIOLOG

Frederik Pohl

Winner of four Hugos at World Science Fiction Conventions for writing and for editing, and recipient of two Nebulas by the Science Fiction Writers of America, Frederik Pohl is the quintessential man of science fiction. He started reading science fiction at age ten, began writing at twelve, and first published in a science fiction magazine at seventeen. He edited a succession of science fiction magazines, starting just before World War II, including Astonishing Stories, G-8 And His Battle Aces, Super Science Stories, Galaxy, and If. He was executive editor at Ace Books and until recently, science fiction editor at Bantam Books.

Fred was one of the best known science fiction fans of the 1930s, forming an association with other aspiring writers, "The Futurians," subject of Damon Knight's book The Futurians, John Day, 1977. Born Frederich Georg Hans Gerhart Erich Otto Heinrich Kurt Pohl, the use of multiple pen names came easily to him. Many of his writings, including perhaps his most famous, Gravy Planet/Space Merchants, with Cyril Kornbluth, have been collaborations. His first Analog (Astounding in those days) story, Heavy Planet, was done with Milton A. Rothman under the name Lee Gregor for the August, 1939 issue. More than thirty years elapsed before Fred appeared in the March 1972 Analog as a sole author with "The Gold at the Starbow's End."

He was born in New York City, but was taken a few weeks later to Panama. He was raised there, and in Texas, New Mexico, and California. A high school dropout, Fred is a highly educated and cultured person. Among other distinctions, he is the Encyclopedia Brittanica's authority on the Roman Emperor Tiberius. Early jobs included restaurant busboy and racetrack urine collector. Since then, he has, aside from running a literary agency for several years, worked exclusively at writing and editing.

A witty and urbane speaker, Fred is much in demand as a futurologist panelist and keynote speaker at business and association meetings, as well as on late night talk shows. He has a passion for violin concerti, and is considering a book on the subject.

In 1972, Fred was professional guest of honor at the World Science Fiction Convention in Los Angeles. This year, he received the Nebula for best novel, Gateway (St. Martin's Press and Ballantine Books).

For further information on the compleat science fiction fan, editor, and writer, consult Fred's just-published, hardcover, 100,000 word autobiography, The Way Tomorrow Was, Del Rey Books.

by Jay Kay Klein

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lieged to be the remnant of a Chinese settlement, and the major herd which is constantly replenished by infusions of new blood from Earth. They are my hobby. They give me more pleasure than any other of my possessions, although they do not sing. Oh, a few do, and there is legend that on Earth there are those who sing as beautifully as, even, perhaps some of my flock. And each new replenishment I study carefully to hear if there is a singer among them, and always I am disappointed.

It is sung that when Medea was first visited from Earth there was a biological enmity between the organisms from the two planets. No Earth creature could eat a Medean organism, or even survive in comfort near one. No Medean could tolerate the presence of creatures from Earth. This is well sung and therefore true, but it is hard to believe.

It is further sung that the Earth persons, my recombinant ancestors, were skilled in the manipulation of genetic materials. So they succeeded before very long in finding procedures which suppressed the bad reaction between the two kinds of beings, and succeeded soon after in causing them to interbreed. I sing of interbreedings between plants and lower forms of life at first, but it was not long before their art reached higher. There is clear truth in that. Am I not here?

It has also been sung that the Earth-ancestors wished to use the beings of Medea and the produce of the planet to enrich Earth—not to put too fine a point on it, to loot my planet. This is not sung any longer in my swarm, nor among the abo swarms nearby who acknowledge my leadership. It would be disrespectful to my ancestors. Now and again the storm winds will bring us a tatter of a swarm that holds to the old songs. Sometimes they sing of this. But if they do not learn to stop by themselves we stop them.

In this private memoir I will admit that the song may be true. It does not matter. What my ancestors may have looked for is one thing. What they found is another. What they found is me, and my siblings, and all of the generations from the time of the recombinant breeding till the end of the world.

They set about to create a being that would have all of the majesty and greatness of Earth, and all of the free-flying beauty and spirit of Medea. And now, in the tenth generation, here am I.

The proof of all this is that I rule.

Who do I rule over? I rule over the six herds of fuxes. Once they fed upon my aerial ancestors when they could. Now they come to me and my swarm for the dreammaking drops. They will eat each other before they will harm one of us. (I do not, of course, mean the abos. When they can catch one of those they eat it, all right. I do not interfere.)

I rule over the Earth persons. They are my own blood, which the fuxes are not. But they too come to me for their dreams.

I rule over the abos, the unchanged

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primitive stock of balloonists that supplied half my heritage. I rule them through fear, because they know that my kind can destroy them if we will, for the weapons that will do this are my gift from my Earth-ancestors.

And finally I rule over even the other recombinants. I rule because I am bigger and stronger and wiser, and because I have the songs to outsing them. The diviner was right.

So I have sung this story into one of the objects the replenishments bring me from Earth. It is a machine, but there is too much Earth in me for me to hate machines uncritically. This is a good machine. It records my song. When I play it back I can hear the glory with which I sing, and so I am reassured once more, by the beauty of my song and the majesty of my presence, that I am indeed the one who must rule.

And perhaps not only one little corner of Medea. Perhaps, one day, all of Medea, even the encampments of the two-legs and the scattered settlements, as far as the frozen lands, wherever winds blow and songs may be sung.

And perhaps, one day, not only Medea.

Chapter Three

This big bobbling gasbag thing came toward me, the size of a calf and covered with pink and green polka dots.

Thirty years before the footlights came to my rescue. I stood tall and confronted him as fearlessly as I ever faced down a ravager, or assassin, or the English troops with their torches to set me afire; oh, I was good. The hard part was not laughing. He did look so very peculiar, with that skinny body glued to the bottom of the big balloon, creasing it—I know what he looked like, he looked like my ex-husband's pajama bottoms from behind, as he sat on the edge of the bed to fumble for his slippers. But, oh, my, there was no comedy in him, this thing. He reached out that long, fragile arm and tweaked my breast.

"Hey, stop that!" I cried.

He bounced back, grabbing the fellow named Jimmy Cargle by the hair. The sleepy eyes in the pale, squeezed-in face opened wide to look at me, and he sang something in that irritating high-pitched yodel they used.

"Speak up, man," I told him. "I can't understand you."

The eyes didn't seem sleepy any more. They were looking at me very carefully, and they were scary. The men from the rocket had been herded off, almost out of earshot, and I felt pretty alone.

The gasbag tried again, and this time I understood him. "Sing for me, Swanilda-person," he shrilled, way up in the high coloratura.

"Why not?" I thought for a minute, and gave him a few bars of my all-purpose spaghetti aria:

"Cara nome, un bel di,
"Una voce poco fa.
"Mi, mi chiamano Mimi,
"Una furtiva lagrima."

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I gave him plenty of shake in the third and fourth lines, a real burlesque bel-canto. But nobody was laughing, least of all him.

"You sing in strange words," he complained. "And when you use words I know, you do not sing. Why is that?"

I was getting used to his register—not his fault, I knew; it was because he was using hydrogen to sing with, and that elevates the voice. I used to know a faded prima donna who carried a helium balloon into recording studios, and took a lungful of gas before the high parts in *Lakme*. I said, carefully, and with attention to pitch, "Who are you? And what is going on here?"

"I am J-Mark," he sang, in that reedy, nasty voice. And that was all. He studied me a while longer, and then commanded: "Taste her, fux!"

One of the little red beasts crawled toward me, belly against the ground, eyes on J-Mark. He darted a quick look at me and whined, "Lord! She may harm me."

"Taste her!"

The fux whimpered and then, quick as lightning, snapped at my hip. I yelled and kicked him rolling across the ground, his tail lashing, legs scrambling, folds of skin extended like sails to help him keep his footing. I clapped a hand to my hip and it came away bloody. "What the hell's going on?" I shouted.

"Be still," commanded the big balloon. "Well?"

The fux chewed his cud for a second, little yellow eyes on me. "Oh, lord," he said at last, "this one tastes bad! There is pain and death in her."

"I do not seek your opinions, just the assay."

"Yes, lord. There is no genetic *incompatibility*," said the fux unwillingly. "But, lord, I implore you—"

"Stop before you do yourself harm," sang the figurehead below the bag, letting go of Jimmy Cargle's hair. He drifted up and away, and the other balloons followed him. J-Mark sang something. The others picked it up like an oratorio, mazing the words, but what he seemed to be saying was: "Prepare her for the mating."

Now, there was a time when if somebody had said that I would have felt pretty cheerful. If *anybody* had said that. That was before the six months in Switzerland.

You don't know what it's like to be getting along in years and still go for the boys. You see, they don't go for you.

It isn't fair because, in any practical sense, you've still got everything you need. The body runs just fine; mine finer than most, if I may say so, the juices still flowing, the booz not even sagging, or anyway not any more than when I was thirty-five. But under the eyes were those terrible black bags. And it doesn't matter how many little clusters of flowers you put at the bodice, the wrinkles of the neck still show and the hair, Jesus, even the hair gets thin. Aging ladies don't get nastier looking than aging men. They just get looked at harder.

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What to do?

Switzerland, that was what to do. I took every dime I had stashed away and bought an appointment in a clinic in Lausanne. They tucked my skin and emulsified my collagen and even implanted my follicles, all part of the service, nothing is too good for the people who have the money. Especially the collagen. That's the part in the larynx that gets all harsh and brittle. It makes the voice crack, and a singer with a cracking voice isn't a singer any more. What she is is dead. The word we use for that is "mime," and you can hang on in miming parts for a long time, but you know, and the audience knows, that the best part of you is gone. But after the time in Switzerland the voice was back. And so was a lot of the rest of me. By the time I was out of convalescent care I could look in the eyes of the Turkish orderlies, and their eyes weren't saying, "Gee, she must've been something once," any more. What their eyes were saying was, "Let's get it on."

Of course, they were Turks. Not even the Swiss could carve off that extra thirty kilos. I would have to do that myself. Only I didn't. Food just tasted too good and, besides, I've seen it happen before, somebody spends the wad on plastic surgery and then goes on a crash diet to top it off and, bam, the loose skin folds back around the place where the fat used to be and they're as bad as before, only skinny. And broke. So it didn't do all that much good for me, Switzerland didn't, except what you could call socially. There must be a lot of Turkish blood in a lot of opera-lovers, especially the old, bald ones. I didn't do much on the stage, but, oh, the curtain calls I took in the dressing rooms!

"You can put your clothes back on," said Jimmy Cargle. He was holding me by the dangling ends of my braids, but he wasn't looking at me. What he was looking at was, actually, a rather strange sight. The balloons had halted a few meters up and not far away, and all the men from the ship were being dragged underneath them by the people who had come to meet us. The resident males were all anticipation, the ones who had come on the ship with me apprehension; but then from the bobbing balloons came a spray of glistening moisture, falling on them all alike. And all their expressions became the same. Newcomer or oldtimer, on every face there was suddenly such a look of mellifluous joy as I had not seen since I let a Milanese impresario sniff my instep.

"What are they doing?" I demanded.

He took his longing eyes off them and said, "Getting their kicks, Swanilda. That's what keeps us here. Only you don't get any right now, because *he* said you didn't, and I don't get any either because I have to watch you. On the other hand," he went on thoughtfully, shifting hands in order to fondle the small of my back, "sooner or later you'll probably make it all up to me."

I swallowed and tolerated his hand. "Jimmy," I said humbly, "please tell me what this is all about. I don't

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SFACROSTIC by Michaele Hahn

A The powers of darkness always have them.

135 104 81 151 114 28 83

B You have some in your pen point.

163 98 5 53 136 4 193

C. What Captain Garamond did quickly when Harald died.

59 40 129 161 118 84

D Members of a Norton matriarchy.

13 93 175 8 72 105 31

E What John Lyle and Zeb wanted to do to the rebellion.

60 137 78 150 176 106 85 42 24

F The ominous Shakespeare of Sir Ector's Mews. (2 words)

50 71 7 100 156 66 182 139 29 127 171 186

G Subterranean

48 190 146 14 121 178 32 183

H Poor abused little alien.

177 15 49 130 152 89 94 140

I Paul Atreides never was.

63 33 124 153 174 12

J Real life spokesman for the stars. (2 words)

34 1 73 90 61 143 138 107 162

K This author gave Dr. Full and Dr. Hemingway the same cures.

189 54 141 101 185 11 86 43 123

L Medieval throwing weapon.

158 87 102 62 35 16

M Some say Mr. Ellison does it.

168 2 15 128 120 77 179

N Sweet out medicinal.

9 51 65 69 165 132 147 194 26

O The Grey Mouser dabbles in it.

70 167 180 148 3 82 131 91

P Hirohito's father

74 133 41 44 55 125 18 36 187

Q Capital of Kwangsi province.

52 75 195 145 45 169 20

R Tiptree's sweetest Frankenstein.

157 97 23 108 37 64

S. The earth is ours.

67 155 92 109 79 22 122

T. He brought the dreaded elixir of health to diseased Pergamon. (2 words)

170 46 184 76 68 27 10 95 88 149 80

110 191 30 56 142 38 134

U. 1955 Hugo winner.

21 126 111 154 192 159

V. What Van Rijn sought.

96 113 196 188 25 57 172

W. You and me and the aliens.

39 119 144 19 160 99

X. Shreds.

6 112 103 166 181 197 116

Y. Lowbrows would call it a baby.

164 17 47 58 117 173

		1J		2M	3O	4B	5B	6X	7F	8D	9N
10T	11K	12I		13D	14G	15H	16L	17Y	18P	19W	20Q
	21U	22S	23R	24E		25V	26N		27T		28A
29F	30T	31D	32G	33I	34J	35L		36P	37R	38T	
39W	40C	41P	42E		43K	44P	45Q	46T	47Y		48G
49H		50F	51N	52Q		53B	54K		55P	56T	
57V	58Y		59C	60E	61J	62L	63I	64R	65N	66F	
67S	68T	69N		70O	71F	72D	73J	74P		75Q	76T
77M		78E	79S	80T	81A	82O		83A	84C	85E	86K
87L	88T	89H	90J	91O		92S	93D		94H	95T	96V
97R	98B	99W	100F	101K	102L	103X	104A	105D	106E		107J
	108R	109S	110T	111U	112X	113V		114A	115M		116X
117Y	118C	119W	120M	121G	122S	123K		124I	125P	126U	127F
128M		129C	130H	131O	132N	133P	134T	135A	136B	137E	138J
	139F	140H	141K	142T	143J	144W	145Q		146G	147N	148O
149T	150E	151A	152H	153I	154U		155S	156F	157R		158L
159U	160W	161C	162J	163B	164Y	165N	166X	167O	168M	169Q	170T
171F		172V	173Y	174I	175D	176E	177H	178G	179M		
	180O	181X	182L	183G	184T	185K	186F		187P	188V	
189K	190G	191T	192U		193B	194N	195Q	196V	197X		

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understand. Where's the colony? It isn't the way I expected at all! I thought I was going to be welcomed with—hell, I don't know, maybe not a brass band exactly. But not this."

He looked at me with haunted eyes. "So did I," he said.

"But then—"

He said, "Get on back to the pens, Swanilda. I'll tell you about it while we're getting you ready."

"Ready for what?"

He looked at me closely. "I bet you know for what," he said, and grinned.

He talked as we walked. I tried to listen, but it wasn't easy; I kept thinking about what looked like my next big performance, and it didn't look like fun. Anyway, most of what he was saying was stuff we all knew about Medea: There were three dominant races on it, the balloonists, the fuxes, and human beings. When Medea was first visited there were only two. Then only one, but a different one, as the Earth colonists, with the superior weapons, fragmented and destroyed the cultures of the autochthones.

That part we had all known back before I left Earth. Us God-ordained human beings had brought mental health and the wonders of science to the poor savage Medeans. But then something had happened.

I began to listen more closely, because this part was new. The first attempts were made to farm good old Earth food on Medea, artichokes and avocados and beef cattle. No go. Each biology triggered the immune responses of the others, and they killed each other. Then someone got busy with recombinant DNA, cross-linking Medean and Earth genes. It worked for plants. It worked for livestock.

Finally it worked for human beings and both fuxes and balloonists. The crosses with the fuxes didn't amount to much, Jimmy didn't say why. But with the balloonists—

"Well, you've seen *him*," Jimmy said, and looked quickly over his shoulder as he spoke.

"Bloody awful he is to see, too."

"Watch your mouth, lady!"

I tried to put myself in his position. He was obviously scared, and maybe he knew a reason I didn't know. So I said, "J-Mark? He's nothing but a bubble of hydrogen gas with a skinny human being tacked onto it. Why does he scare you so much?"

He managed a laugh. "*Scared?* That's funny, Swanilda. There's nothing to *scare* me. It's just—" He sighed. "Well, they have it all over us in one way," he said. "When they come, the stuff is like the best dope you ever had in your life. A high you wouldn't believe! The first settlers used to keep a couple around just for the highs, you know, Saturday night you go out and tickle a couple of balloonists and tie one on. Now—well, now they're the ones who keep *us* around. We're addicted. Or at least," he said, staring contemptuously at the other human beings, wobbling euphorically in the same general direction as we were going, *"they* are. I could personally kick it any time."

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"Then why—"

"Oh, shut up, Swanilda," he said, exasperated. "I'm a boss, can't you see that? I've got first pick of everything. So it's just not to my advantage to want to change anything."

He rubbed his chin for a minute, and then nodded decisively, "Yep, it's a good way to live, Swanilda," he said. "*He* sees that we get high when we need it. In return, we keep the fuxes in line for *him*. The fuxes do the hard work, food and all that. And we all live happily together, and where is there a better life for anybody?"

Well, I could have named fifty without stopping to think, starting as low as being a tenor's personal valet. But I could see he didn't want to hear that.

"Now get in the pens," he ordered. "One of the fuxes will clean you up and tell you what to do."

"Can't you stay, Jimmy?" I wheedled. His company wasn't that much, but it beat anything else I'd discovered on Medea.

"No way, lady. I've got—uh, I've got something to do. See you later." And he turned and was off at a dead run, toward where one of the balloons was still bobbing impatiently, ready to give him his personal shot of the joy he wasn't really addicted to.

The fux in charge of getting me ready was the same one who had nipped me in the rump. You could tell he was scared, but I tried to put him at his ease. "I'm not going to kill you," I said.

"Thank you, person! Here, let me help you—" And he licked the wound clean. Curiously, it seemed to help. The bleeding had stopped, and the ugly color went out of the bite before he had finished.

"Is it better?" he asked, sitting back on his haunches and lolling his tongue out at me.

"It'll do. Now what?"

"You bathe." And he backed away, and tugged at a lever with his teeth, and a barrel of water fell over me. I came out roaring and gasping, but a little clean.

"Now take off those clothes," said the fux, dexterously shaking out a fold of a gauzy material. When I was bare enough to suit him he draped it over my shoulders. "You do not seem frightened, Swanilda-person," he observed. "No doubt you are grateful for the honor?"

Well, grateful I was not, but I wasn't particularly frightened, either. J-Mark was not, taken all in all, a lot worse than some concert managers I've dealt with. But I wasn't happy either. Queasy describes it. I said, "I've never done, uh, anything like this before. I mean, with another species."

The fux sat back on his haunches, regarding me. "I don't think I have enough fabric," he said meditatively.

"Is that, uh, common here? I mean, do the different species mate?"

He barked a laugh. "All the time, Swanilda-person, all the time."

"And that accounts for half breeds like big-belly?"

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"Well, no. Intraspecial sex isn't fertile. You need a specialist in protoplast preparation. You can work with the plasmids, but not usually the gross gametes."

"Uh-huh," I said helpfully, but he was finished. I asked, "Is it only between humans and the balloons?"

"Oh, no, person! Between humans and fuxes, too. Even three-way breedings . . . as," he added, chuckling. "you will no doubt find out. Our lord has selected for certain of our characteristics, too." He busied himself nipping at the gauze for a moment, then said, "It is admirable in you that you are not afraid."

"How about you? You don't seem scared by him."

He barked again—it was hard to be sure whether he was laughing or angry. "Why should I be? Two seasons ago I was still in my rutty prime. *Then* I would have been afraid. *Then* I didn't want to die. But now—"

He sighed, and threw the gauze over me again. "They tell me," he said, tugging it this way and that, "that in another season or two I will reconcile myself to the change of life. Then it will seem terrible to me that at one time I was so obsessed by sex. Now— Now, Swanilda-person, it doesn't seem terrible at all."

* * *

I could hear my dear companions of the flight from Earth, but they were in another pen, and to judge from the sound of them they were even less happy than I. If such a thing can be imagined.

At least I was left alone for a bit, presumably to sleep. The permanent ochre light gave no cue for that, and I wasn't sleepy anyway. What I wanted was a bottle of wine, a pack of cigarettes, and a man. The first didn't exist. The second was pretty skimpy; I was down to two cigarettes in the pack. And the third was not exactly what I had had in mind. I was beginning to piece things together in my mind. Obviously old J-Mark was running some sort of shanghai racket, diverting shipments from Earth to his personal pleasure, which implied that somewhere on Medea there must be the place where we should have gone. Where, maybe, somebody would be interested in rescuing me, if only I could figure out a way of getting in touch with them.

But that didn't look easy.

If I could get to the ship—

But even if I did, I really hadn't paid much attention to the radio. Or to anything else except the men and the way my tooth felt. Harry Bechmann

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could probably take care of the whole thing standing on his head, if I could talk to him, and if we could get to the ship, and if—and, most of all, *if* he showed any interest in that. From the way Jimmy Cargle acted, I wasn't real sure that would be so. Whatever the loons squirted out of their sex organs, it seemed to be pretty powerfully addictive. Now that I thought of it, I had heard something about that on Earth. It had seemed pretty funny at the time, getting a balloon to, ah, how would you say it?, abuse himself so you could get a high from the semen. I hadn't really understood how that worked for the fuxes, but maybe it had something to do with the fact that old J-Mark was part human. The hallucinogenic effect had something to do with the incompatibility between Earth and Medean biochemistries, and no doubt it could work both ways.

Regardless. Jimmy Cargle showed no real desire to be free of the tyranny of the balloonists. I had the desire, all right. But I didn't see any good way to accomplish it.

Was ever a soprano so beset by would-be ravagers and pain?

All the time, friends. But in my previous experience, only on the stage.

Chapter Four

It is one of the sacred obligations of my high station to judge the disputes and transgressions of lesser beings. Like most sacred obligations, it is a bore. I listened to one two-leg complaining about the theft of clothing by another, and to females of my flock desirous of bearing young. It is well to dispense justice with an even hand, and so I have strict rules by which I abide for such judging. When one servant complains against another, I punish both. When a servant petitions for a favor, I refuse it. This increases the understanding of my fairness, and it also reduces the number of cases brought before me.

The only interesting case was that of an aging fux, but that was of great interest. He was a trusted servant, whom I had graced with the charge of those biological facilities which make it possible for our hybrids to exist. He had failed his trust. The poor creature had been so misguided as to attempt to pervert the use of his laboratory to an effort to restore potency to his poor post-rutty gonads. This was not merely ill-judged. It smacked of vice, and I have always had special care to stamp out vice among my servants, bearing in mind the words of the diviner.

He cowered as he heard my song, for he could hear my anger in it. "You have misused my property," I sang, and the flock choired agreement. "What will you sing before I pass sentence on you?"

"Lord," whimpered the sad little thing, "I have no defense. I know I have done wrong. Only—" He hesitated, peering fearfully up at me. As though anything he could say might make his position worse!

"Sing on," I commanded justly. "I will hear."

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He sniffled, and then went on. "Only in the old days it was different, lord. We were honored when we passed the rutty time. We were honored for the wisdom of our age, and our words were given much thought. Now that is gone. Our people are slaves to yours. We live only for the dream-milt, and there is nothing in our lives any more that smells as good as the memory of a breedy female."

My ground-servant lashed his tail in fury, peeking up at me for a cue. "What filth, lord!" he cried. He was trying to curry favor, but he was right to do so. I gave him an opportunity to increase his esteem in my eyes.

"Say the punishment for this fool," I invited him.

"Let him be slain!" Fuxes are all alike. They have no loyalty to each other.

"Say on," I sang invitingly.

"I will, lord! His smell is most vile in what he says. Oh, to be sure," he went on, staring angrily at the accused one, "perhaps in some ways the old days were more filled with, ah, with empty pleasure. Without disrespect, this is possibly so. When our races were equal—" He paused to see if I was angry, but I remained silent. Fuxes can never tell anything from our expressions. "When our races were equal and the two-legs had not yet come from the stars, yes, then there was a kind of freedom which no longer exists. We ate well on each other, lord. When our ancestors caught one of yours, ah, the taste of him! Then your ancestors were only balloonists, not yet contam—not yet enriched," he corrected himself, looking up at me warily, "with the admixture of other genetic materials from the two-legs. That was certainly different, lord. Not better. No, certainly not better! In no way was it better, or even as good—"

He trailed off miserably, perceiving at last that he had said too much.

After a moment I sang, "Shall I punish one and not the other?" He made no answer. By the color of his eyes and the tremor of his paws it was clear that he knew what was ahead. Fuxes are not fools, at least when postgonadal. "Then let them both be slain," I sang justly, and the swarm chorused agreement with my wise decision.

The Earth-servants stepped back and formed a ring around the two, and shot them full of missiles. The other fuxes looked glum but did nothing to interfere.

When they had stopped trembling in death I asked, "Is there any other case to be judged at this time?"

My servants looked around at each other, and then one of the two-legs spoke humbly. "No, lord. We are grateful for your wisdom."

"Of course," I sang, and my swarm raised their voices in exultation at the justice of my judging. The ground-servants studied each other's expressions to make sure that all were showing agreement. Of course they were; and we let go our holds and rose toward the sky.

* * *

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Judging is a downer, but as we soared my spirits were restored. I sang. Although I always sing well, I am sure that I sang even more beautifully than usual that day.

I sang of my virtues, for that is always a popular theme with the members of my swarm. And now, you ask yourself, how can J-Mark know what is popular or not, since none would dare speak against the beauty of his voice? That is a wise question. I have often punished servants for asking it, but no one can punish me and I have asked it of myself, and this is the answer: Since I am lord of the flock, it is I who set standards for all. And I like it. Therefore all others must.

It is by this process of syllogistic logic that I have disposed of other nagging self-doubts that might otherwise have troubled me. I give you an example. The two-legged servants from Earth and the ground-servants obey my every order. But what is to tell whether they do so out of loyalty and love, or merely out of addiction to the hallucinogens in my milt and perhaps terror at the thought of reprisals?

When I was newly swollen to rule these thoughts crossed my mind, but here is the argument with which I disposed of them: It is known that there are settlements of two-legs which do not acknowledge my mastery, and also many herds of fuxes in other parts of the world. What is the difference between them and my loyal subjects? It is only that these others have not had a chance to know me well, and thus to love and obey me. It would be a virtue to give them that chance. And, as my diviner foretold, I am destined to live for virtue.

So I sang of these things as we soared. I sang of the proud heritage of my line, and then, because my mind was full of my strong new singing female from Earth, I sang of her. Her body was of course repulsive, and my song reflected that. But that was a small matter. Her genes could be of great value. It was sure that the day would come when I would rule all of Medea, but why only Medea? With a new mother from Earth, my descendants could rule both planets?

And it was of this that I sang, of the two-leg female from Earth, and of the descendants I would have from her body. Some of the females at the edge of my flock were furious. One of them even dared sing a counterpoint about the virtues of a pure hereditary line, but I did not bother to chastise her. She had flown under every male in my flock, and we all knew how to judge her "purity."

My song became harsher as I sang of the female two-leg's qualities. Her body was much too dense. Her singing was very poor indeed by our standards. And I did not care for the stink of her. Even washed up, she was all salt and congeners and not enough good healthy methane. I could have her disinfected, but the attempts I had made in doing that sort of thing to two-legs before had been unfortunate for the two-legs. Worse. What of her mind? Could she transmit to our

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descendants that intelligence and acuity for which I and all my line are famous? She did not seem to understand all that I sang to her, although I had been careful to reinforce my song with figures of speech and factual material culled from my considerable knowledge of Earth. And I came back to her song. She could never sing with the flock, I thought, and my song took on a dejected note that caused the younger members of the flock to falter and float closer to the grown ones.

But what was I thinking of? She could never fly anyway. Not with that gross, solid body, totally lacking in gas-sacs. Ground-bound and ugly, ill-smelling and, like all two-legs, addicted to vicious practices, slow of wit and gross of voice—what was I thinking of indeed?

Yet there was no real need for me to concern myself with any of these things. My body did not have to come in contact with hers in any closer way than to any other Earth-Servant. It would be seemly to perform a copulation with her once for the sake of tradition, but how long could that last? Then it was only her chemistry I needed, not her flesh. The flesh could be dispensed with entirely once a properly compounded ovum had been constructed. Whether the ovum ripened in her body or some other was of no consequence.

As I realized that, my song soared and grew, and all the flock joined in the chorus of joy. All but a few of the females.

That was a separate problem to trouble my serenity. In the days of old, while our females launched their eggs wherever the winds might fly them, no female ever felt concern about the fate of the offspring. Now that some of them had live-birthing bodies new problems were beginning to arise. "Their" children should inherit. "Their" descendants were preferred over others. It had been a mistake to include them in the recombinant strains. But it was not a mistake that could not be rectified, if they did not mend their ways.

With my mind at peace, I sought my two-leg bride and entered into her breeding pen. I clung to the padded top of the roofless walls and looked down to behold her.

At least she retained a sense of humor. "Get lost, freak," she joked.

I have always been able to jest with my inferiors in a completely open way, so I returned her gay mood. "It is amusing, is it not," I sang, "that this greatest occasion of your life may also be your last?"

"What the hell are you talking about?" I could not help it, I shrank back from the raucous sound of her voice. She did not sing well, indeed! Her voice was a full octave deeper than was proper even for a full-grown male, although at certain times she could reach a reasonable pitch. Even then, her song was hardly more harmonious than the mating screech of a rutty fux.

Yet what had to be had to be. I was

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determined to put her at ease, and so I stretched down to catch her hair, pulling myself to her level. "Cut it out, tick-face," she said humorously, as I clambered down her side until our faces were close together.

Then she did a thing hard to forgive. She made as if to strike me.

My little ground-servant was close by and caught at her arm in time to stop her—fortunately for both of them. The female shrieked, perhaps because of the sharpness of his teeth, and the fux mumbled, through his mouthful of her arm, "Shall I kill her, lord?"

I did not answer at once. The matter required thought.

A jest was a jest, but joking should not go too far. For a moment I considered omitting the copulation, but, as everyone who knows me will attest, it is a part of my personality to carry to completion whatever project I embark upon. Yet I could not allow her to offer me physical violence! I could have had her bound. Or muted. Or domesticated, as the other Earth-servants were domesticated. That would happen in any event after the copulation, since the ecstasy of my divine seed would addict her and tame her forever. But the symbolic mating itself was another matter. I did not want a zombie-bride. I wanted her to want me. For that I chose to rely not on the narcotic powers of my semen, but on my golden song. I would sing her into it.

And so I sang, "Release her." The fux slunk away, frustration and puzzlement all over him. He knew what would have happened if any other servant had dared such a jest. "Not too far," I cautioned, and he grumbled:

"Yes, lord."

"I will now seduce this female," I explained. "You are charged to intervene if she seems about to harm me. You will not fail in this."

"No, lord."

I turned my attention to the Earth female. "Swanilda," I sang, "I have decided to father a child on you. Your DNA patterns show no material lethality or teratogenicity, and they comport well with mine. So you will parent the next ruler of our flock, and perhaps more than our flock."

She seemed agitated. "*What*?"

I winced. "I know the honor is overwhelming," I sang, "but please keep your voice down. Let me explain how this is done. There will be a copulation, but that is not where the impregnation will occur. That is only for tradition's sake, and, of course," I added gallantly, "because I lust after your flesh." There was no truth in that, but I wanted to make her feel good. It costs nothing to be considerate, when possible. "The actual impregnation will occur in our molecular biology laboratory. An ovum will be removed from your womb. Certain chemicals from your genes and mine will be implanted in it. Then it will be returned. Of course, it will be rather large, and as it develops there will be some discomfort. But you will be able to carry it to term. My fuxes never fail

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log

A Calendar of Upcoming Events

29 September-1 October
PgHLANGE X (Pittsburgh area SF conference) at Marriott Inn, Pittsburgh, PA. Guest of Honor—Rick Sternbach. Fan Guest of Honor—Phil Foglio. First 300 registrants receive a signed, numbered portfolio of the GoH's artwork. Registration: $7.50 until 15 September, $10 thereafter and at the door. Info: Barbara Beraud, 1202 Benedum-Trees Bldg., Pittsburgh PA 15222.

14-15 October
OCTOCON II at Santa Rosa, CA. SF and Fantasy Convention. Films, artshow, blood drive. Registration $6 (supporting), $8 (attending) until 31 August, $7 (supporting), $10 (attending) thereafter. Info: Box 1824, Santa Rosa CA 95402. Enclose S.A.S.E.

16-18 October
19th Annual Symposium on the Foundations of Computer Science at Ann Arbor, MI. Info: Prof. William C. Rounds, Computer Science Department, Univ. of Michigan, Ann Arbor MI 48109.

23-25 October
Digital Satellite Communications of Montreal, Quebec. Info: Manager of Administrative Office, ICDSC-4, Teleglobe Canada, 680 rue Sherbrooke ouest, Montreal, Quebec, H3A 2S4, Canada.

15 October
Deadline for entries in the NESFA Annual SF Short Story Contest. Write for rules BEFORE submitting entries. Info: New England Science Fiction Association, Box G, MIT Branch PO, Cambridge MA 02139.

23-27 August 1979
SEACON 79 (37th World Science Fiction Convention) at Metropole Hotel, Brighton, U.K. American Guest of Honor—Fritz Leiber; British Guest of Honor—Brian Aldiss; Fan Guest of Honor—Harry Bell; Toastmaster—Bob Shaw. Registration $7.50 (supporting) to 31 December 1978, $15 (attending) to 31 December 1978. Info: Seacon 79, 14 Henrietta St. London WC2E 8QJ, U. K. This is the science fiction world's annual get-together. Professionals and readers from all over the world will be in attendance. Talks, panels, films, fancy dress competition, banquet, the works. Join now and get to nominate and vote for the Hugo awards and the John W. Campbell Award for Best New Writer.

ANTHONY R. LEWIS

*Items for the Calendar should be sent to the Editorial Offices, **four months** in advance of the issue in which you want the item to appear.*

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in this. They would not dare."

The female was shaking, evidently from astonishment and joy. As a precaution I transferred myself to the fur of the ground-servant. "Are you all right?" I asked solicitously.

She laughed that terrible, untuned laugh. "I guess you could say that. Just sort of, what would you say, taken aback. I've never been a mother before."

"The greater the virtue," I sang in approval.

"And honest, J-Mark, I'm afraid it won't work. I mean, I had my laparascopy long ago. No kids."

"*Fux*!"

The little creature buried its head in its paws and peered up despairingly. "Lord," it whined, "it is true, there was a surgical intervention in her of the kind the two-legs practice to prevent pregnancy. But we can easily bypass that. Ova are still formed in her. They will be vital. Not many. She is not of prime breeding age. But she will conceive, yes, lord."

"Are you sure?" she demanded. "That son of a bitch doctor promised me no kids!"

My good humor was restored. "If my fux says it is so, you need not worry," I sang benevolently. "So, my dear. All is in order. Shall I begin the copulation now?"

She seemed quite distressed, and I helped her over her nervousness. "Wait," I sang graciously. "I will call our flock to observe the ceremony. They will find it very interesting."

I sang the flock down to the mating pen. They perched warily on the padded walls, peering down, singing querulously to each other. I was displeased and embarrassed. "Come closer!" I commanded. "And sing joyfully of what is about to happen if you would give your lord pleasure."

Knowing what was good for them, they sank down to cluster around us and began to choir more harmoniously. The two-leg jumped away as one of them caught at her hair. "No, no," I sang in jolly phrasing, "do not be too eager. The Swanilda person must be unencumbered for the mating."

"Yeah, now, wait a minute," she said, staring about at the members of my swarm in awe and reverence. "I don't usually do sex shows. Not in public. And even the concert managers usually throw in a little foreplay."

The term was unfamiliar to me. I resolved to deal with the fuxes who had failed to teach me properly, and was compelled to sing, "I do not think I have any foreplay."

"I wouldn't doubt that, tick-face," she said, her natural light-heartedness showing itself again. "Doesn't the condemned woman at least get a last cigarette?"

Another word I did not know! "I do not think I have any cigarette, either."

"That at least I can supply for myself," she said, rummaging in her discarded Earth clothes. And from them she drew out what looked like a bent paper cylinder, and also what looked like, and was, a forbidden thing. A machine to make flame.

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I sang my command at the top of my voice, a long fortissimo "No-o-o-o-o . . . " But she had already produced the flame, and to my utter, and final, horror my voice itself, the God-breath of hydrogen that gave me song, became a long plume of violet flame. And so ended the last of the greatest line Medea had ever seen.

Chapter Five

And so, dear friends, I saved our world. Maybe all of our worlds. You'd think people would appreciate it more.

When Cargle and Bechmann finally got detoxed enough to get through to the other communities on Medea, I really expected a little more of We owe you everything, Swanilda, and What a great person you are, Swanilda. I expected a lot more than I got. The most pleased you could call them was "mildly." They did, however, help patch me back together again, which was no small job in itself.

Part of what was wrong with me was burns. When I lit my lighter that idiot was pointing right at me, and what was left of my hair went up in smelly smoke. I mean *all* of it. Or at least all of it above the neck, including eyelashes and eyebrows. So I wasn't really noticing when he turned purple flame and burst, or even when the rest of his gang of loonies caught fire from the flaming trash and followed his good example.

His dying scream was a long plume of flame, like a blowtorch aimed right at me. Then they were all going, drippy blobs of fire coming down that were stickily melted parts of their bodies, and drippy blobs going *up* that were pulses of burning gas. The things were all hydrogen inside. They were nothing more than thin skins over fires waiting to explode. I just helped them along. The screaming was awful. The heat was unbearable. And the smell was the worst of all.

Fortunately it wasn't me he was holding onto when he went up. It was the fux. The poor thing lost most of its fur before it could get free, and then it was screaming—not so much with pain as with fear. "Swanilda-person!" it shrieked. "What have you done?"

Well, talk about let downs! What had I done, forsooth.

That's when years of Bayreuth training showed their stuff. Admittedly I wasn't in the cast, but all that Wagner taught me what a soprano was supposed to be, namely heroic. I stood right up to him.

"What have I done?" I declaimed. "I'll tell you what I've done. I've freed you. I've liberated you from a fearful tyranny."

The fux reared back on his hind legs, staring at me through eyes scorched almost sightless. "Freed us?"

"You're bloody well told, I freed you. Now you can live your own lives without that monster ordering you around!"

"Our own lives," he said wonderingly, and then, "Oh, foolish Swanilda-person, I am dead because of you!

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Do you not know that the other servants will see to that?"

And, oh, how right he was. I've faced many a bad audience in my life, but never one as bad as a couple dozen human beings and nearly a hundred fuxes who had suddenly and permanently been cut off from the source of *the greatest high on two worlds.*

Still—I've always been lucky. More or less. They didn't kill me, quite.

When I came to there was a medic from the main colonies patching me up. Young. Deep brown eyes. Shoulders that wouldn't quit. I must have looked like hell, but he was all gentleness, and when he told me that the poor old fux hadn't survived it all his voice was, you know, a pretty good Irish tenor, and even really regretful when he said, "I guess you'll want to be leaving us after this, Miz Guthrie."

"Call me Swanilda, why don't you?"

"Sure, Swanilda. And I can't blame you. Even not counting what happened to you, it's pretty rough here. I've thought about going back myself."

"Have you," I said, propping myself up. "Tell me. Have you ever thought of singing for a career?"

"Oh, sure, before I went into med school. But it's a hard row to hoe if you don't have somebody helping out—well, you know that. Well, I guess you're about done. Can I get you anything to make you more comfortable?"

"Indeed you can, dear man," I said. "A cigarette. Maybe a drink. And then sit down and have one with me, while I tell you about an interesting idea somebody suggested to me, some time back, on Earth." ■

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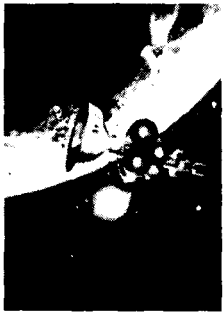

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Arran lay on her bed, weeping. The sound of the door slamming still rang through her flat. Finally she rolled over, looked at the ceiling, wiped tears away delicately with her fingers, and then said, "What the hell."

Dramatic pause. And then, at last (at long last) a loud buzzer sounded. "All clear, Arran," said the voice from the concealed speaker, and Arran groaned, swung around to sit on the bed, unstrapped the loop recorder from her naked leg, and threw it tiredly against the wall. It smashed.

"Do you have any idea how much that equipment *costs*?" Triuff asked, reproachfully.

"I pay you to know," Arran said, putting on a robe. Triuff found the tie and handed it to her. As Arran threaded it through the loops, Triuff exulted. "The best ever. A hundred billion Arran Handully fans are aching to pay their seven chops to get in to watch. And you gave it to them."

"Seventeen days," Arran said, glaring at the other woman. "Seventeen stinking days. And three of them with that bastard Courtney."

"He's *paid* to be a bastard. It's his persona."

"He's pretty damned convincing. If you get me even three minutes with him, next time, I'll sack you."

Arran strode out of her flat, barefoot and clad only in the robe. Triuff followed, her high-heeled shoes making a clicking rhythm that, to Arran anyway, always seemed to be saying, "Money, money, money." Except when it was saying, "Screw your mother, screw your mother." Good manager. Billions in the bank.

"Arran," Triuff said. "I know you're very tired."

"Ha," Arran said.

"But while you were recording I had time to do a little business—"

"While I was recording you had time to manufacture a planet!" Arran snarled. "Seventeen days! I'm an actress, I'm not going for the Guiness. I'm the highest paid actress in history, I think you said in your latest press releases. So why do I work my tail off for seventeen days when I'm only awake for twenty-one? Four lousy days of peace, and then the marathon."

"A little business," Triuff went on, unperturbed. "A little business that will let you retire."

"Retire?" And without thinking, Arran slowed down her pace.

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"Retire. Imagine—awake for three weeks, and only guest appearances in other poor slobs' loops. Getting paid for having fun."

"Nights to myself?"

"We'll turn off the recorder."

Arran scowled. Triuff amended: "You can even take the thing off!"

"And what do I have to do to earn so much? Have an affair with a gorilla?"

"It's been done," Triuff said, "and it's beneath you. No, this time we give them total reality. Total!"

"What do we give them now?"

"I've made arrangements," Triuff said, "to have a loop recorder in the Sleeproom."

Arran Handully gasped and stared at her manager. "In the Sleeproom! Is nothing sacred!" And then Arran laughed. "You must have spent a fortune! An absolute fortune!"

"Actually, only one bribe was necessary."

"Who'd you bribe, Mother?"

"Very close. Better, in fact, since Mother hasn't got the power to pick her nose without the consent of the Cabinet. It's Farl Baak."

"Baak! And here I thought he was a decent man."

"It wasn't a bribe. At least, not for money."

Arran squinted at Triuff. "Triuff," she said, "I told you that I was willing to act out twenty-four-hour-a-day love affairs. But I choose my own lovers off-camera."

"You'll be able to retire."

"I'm not a whore!"

"And he said he wouldn't even sleep with you, if you didn't want. He just asked for twenty-four hours with you two wakings from now. To talk. To become friends."

Arran leaned against the wall of the corridor "It'll really make that much money?"

"You forget, Arran. All your fans are in love with you. But no one has ever done what you're going to do. From a half-hour before waking to a half-hour after you've been put to sleep."

"Before waking and after the somec." Arran smiled. "There's nobody in the Empire who's seen that, except the Sleeproom attendants."

"And we can advertise utter reality. No illusion: you'll see *everything* that happens to Arran Handully for three weeks of waking!"

Arran thoughtfully considered for a moment. "It'll be hell," she said.

"You can retire afterward," Triuff reminded her.

"All right," Arran agreed. "I'll do it. But I warn you. No Courtneys. No bores. And no little boys!"

Triuff looked hurt. "Arran—the little boy was five loops ago!"

"I remember every moment of it," Arran said. "He came without an instruction booklet. What the hell do I do with a seven-year-old boy?"

"And it was your best acting up to then. Arran, I can't help it—I have to spring surprises on you. That's when you're at your best—dealing with difficulty. That's why you're an artist. That's why you're a legend."

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"That's why you're rich," Arran pointed out, and then she walked quickly away, heading for the Sleeproom. Her eligibility began in a half-hour, and every waking moment beyond that was a moment less of life.

Triuff followed her as far as she could, giving last-minute instructions on what to do when she woke, what to expect in the Sleeproom, how the instructions would be given to her in a way that she couldn't miss, but that the audience watching the holos wouldn't notice, and finally Arran made it through the door into the tape and tap, and Triuff had to stay behind.

Gentle and deferent attendants led her to the plush chair where the sleep helmet waited. Arran sighed and sat down, let the helmet slip onto her head, and tried to think happy thoughts as the tapes took her brain pattern—all her memories, all her personality—and recorded it to restore her at waking. When it was done, she got up and lazily walked to the table, shedding her robe on the way. She lay down with a groan of relief, and leaned her head back, surprised that the table, which looked so hard, could be soft.

It occurred to her (it always had before, too, but she didn't know it) that she must have done this same thing twenty-two times before, because she had used somec that many times. But since the somec wiped clean all the brain activities during the sleep, including memory, she could never remember anything that happened to her after the taping. Funny. They could have her make love to all the attendants in the Sleeproom, and she'd never know it.

But no, she realized as the sweet and deferent men and women soothingly wheeled the table to a place where monitoring instruments waited for her, no, that could never happen. The Sleeproom is the one place where no jokes are played, where nothing surprising or outrageous is ever done. Something in the world must be secure.

Then she giggled. Until my next waking, that is. And then the Sleeproom will be open to all the billions of poor suckers in the Empire who never get a chance at the somec, who have to live out their measly hundred years all in a row, while sleepers skip through the centuries like stones on a lake, touching down only every few years.

And then the sweet young man with the darling cleft chin (pretty enough to be an actor, Arran noticed) pushed a needle gently into her arm, apologizing softly for the pain.

"That's all right," Arran started to say, but then she felt a sharp pain in her arm, that spread quick as a fire to every part of her body; a terrible agony of heat that made her sweat leap from her pores. She cried out in pain and surprise—what was happening? Were they killing her? Who could want her to die?

And then the somec penetrated to her brain, and ended all consciousness, and all memory. Including the memory of the pain that she had just felt.

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And when she woke again she would remember nothing of the agony of the somec. It would always and forever be a surprise.

Triuff got the seven thousand eight hundred copies of the latest loop finished—most of them edited versions that cut out all sleeping hours and bodily functions other than eating and sex, the small minority full loops that truly dedicated (and rich) Arran Handully fans could view in small, private, seventeen-day-long showings. There were fans (crazy people, Triuff had long since decided, but thank Mother for them) who actually leased private copies of the unedited loops and watched them twice through on a single waking. That was one hell of a dedicated fan.

Once the loops were turned over to the distributors (and the advance money was paid into the Arran Handully Corporation credit accounts) Triuff went to the Sleeproom herself. It was the price of being a manager—up weeks before the star, back under somec weeks after. Triuff would die centuries before Arran. But Triuff was very philosophical about it. After all, she kept reminding herself, she might have been a schoolteacher and never had somec at all.

Arran woke sweating. Like every other sleeper, she believed that the perspiration was caused by the wake-up drugs, never suspecting that she was in that discomfort for the five years of sleep that had just passed. Her memories were intact, having been played back into her head only a few moments before. And she immediately realized that something was fastened to her right thigh—the loop recorder. She was already being taped, along with the room around her. For a brief moment she rebelled, regretting her decision to go along with the scheme. How could she bear to stay in character for the whole three weeks?

But the one unbreakable rule among lifeloop actors was "The loop never stops." No matter what you do, it's being looped, and there was no way to edit a loop. If there was one thing—one tiny thing—that had to be edited out (other than sleep), the loop could simply be thrown away. The fans wouldn't stand for a loop that jumped from one scene to another—they were always sure that something juicy was being left out.

And so, almost by reflex, she composed herself into the tragically beautiful, sweet-souled yet bitter-tongued Arran Handully that all the fans knew and loved and paid money to watch. She sighed, and the sigh was seductive. She shuddered from the cold air passing across her sweating body, and turned the shiver into an excuse to open her eyes, blinking them delicately (seductively) against the dazzling lights.

And then she got up slowly, looked around. One of the ubiquitous attendants was standing nearby with a robe; Arran let him help her put it on, moving her shoulder just *so* in a way that made her breast rise just *that*

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much (never let it jiggle, nothing ugher than jiggling flesh, she reminded herself); and then she stepped to the newsboards. A quick flash through interplanetary news, and then a close study of Capitol events for the last five years, updating herself on who had done what to whom. And then she glanced at the game reports. Usually she only flipped a few pages and read virtually nothing—the games bored her—but this time she looked at it carefully for several minutes, pursing her lips and making a point of seeming to be dismayed or excited about individual game outcomes.

Actually, of course, she was reading the schedule for the next twenty-one days. Some of the names were new to her, of course—actors and actresses who were just reaching a level where they could afford to pay to be in an Arran Handully loop. And there were other names that she was quite familiar with, characters her fans would be expecting: Doret, her close friend and roommate seven loops ago, who still came back now and then to catch up on the news; Twern, that seven-year-old boy, now nearly fifteen, one of the youngest people ever to go on somec; old lovers and old friends, and a few leftovers from feuds on ancient loops. Which ones would be catty, and which ones would want to make up? Ah, well, she told herself. Plenty of chances to find that out.

A name far down the list leaped out at her. Hamilton Ferlock! Involuntarily she smiled—caught herself in the sincere reaction and then decided that it would do no harm—the Arran Handully character might smile in just that way over a particular victory in a game. Hamilton Ferlock. Probably the only male actor on Capitol who could be considered to be in her class. They had started out at the same time, too, and he had been her lover in her first five loops, back when she only had a few months on somec between wakings. And now he was going to be in *this* loop!

She thought a silent blessing for her manager. Triuff had actually done something thoughtful.

And then it was time to dress and leave the Sleeproom and walk the long corridors to her flat. She noticed as she walked along that the corridor had been redecorated, to give the illusion that somehow even the halls she walked along had class. She touched one of the new panels. Plastic. She refrained from grimacing. Oh well, the audience will never know it isn't really wood, and it keeps the overhead down.

She opened the door of her flat, and Doret screamed in delight and ran to embrace her. Arran decided that this time she should act a little put out at Doret for some imagined slight. Doret looked a little surprised, backed away, and then, like the consummate actress that she was (Arran didn't mind admitting the talents of her coworkers), she took Arran's quite subtle cue and turned it into a beautiful scene, Doret weeping out a confession that she had stolen a lover away from Arran several wakings ago, and Arran at first seeming to punish her, then forgiving. They

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ended the scene tearfully in each other's arms, and then paused a moment. Dammit, Arran thought, Triuff is at it again. Nobody entered to break the scene. They had to go on after the climax, which meant building it to an even bigger climax within the next three hours.

Arran was exhausted when Doret finally left. They had a wrestling match, in which they had ripped each other's clothes to shreds, and finally Doret had pulled a knife on Arran. It was not until Arran managed to get the weapon away from her that Doret finally left, and Arran had a chance to relax for a moment.

Twenty-one days without a break, Arran reminded herself. And Triuff forcing me into exhaustion the first day. I'll fire the bitch, she vowed.

It was the twentieth day, and Arran was sick of the whole thing. Five parties, a couple of orgies, and sleeping with someone new every night can pall rather quickly, and she had run the gamut of emotion several times. Each time she wept, she tried to put a different edge on it—tried to improvise new things to say to lovers, to shout in an argument, to use to insult a condescending visitor.

Most of her guests this time had been talented, and Arran certainly hadn't had to pull the full weight all by herself. But it was grueling, all the same.

And the buzzer sounded, and Arran had to get up to answer the door.

Hamilton Ferlock stood there, looking a little unsure of himself. Five centuries of acting, Arran thought to herself, and he still hasn't lost that ingenuous, boyish manner. She cried out his name (seductively, in character) and threw her arms around him.

"Ham," she said, "oh, Ham, you wouldn't believe this waking! I'm so tired."

"Arran," he said softly, and Arran noticed with surprise that he was starting out sounding as if he loved her. Oh no, she thought. Didn't we part with a quarrel the last time? No, no, that was Ryden. Ham left because, because—oh, yes. Because he was feeling unfulfilled.

"Well, did you find what you were looking for?"

Ham raised an eyebrow. "Looking for?"

"You said you had to do something important with your life. That living with me was turning you into a lovesick shadow." Good phrase, Arran congratulated herself.

"Lovesick shadow. Well, you see, that was true enough," Ham answered. "But I've discovered that shadows only exist where there is light. You're my light, Arran, and only when I'm near you do I really exist."

No wonder he's so highly paid, Arran thought. The line was a bit gooey, but it's men like him who keep the women watching.

"Am I a light?" Arran said. "To think you've come back to me after so long."

"Like a moth to a flame."

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And then, as was obligatory in all happy reunion scenes (have I already done a happy reunion in this waking? No) they slowly undressed each other and made love slowly, the kind of copulation that was not so much arousing as emotional, the kind that made both men and women cry and hold each other's hands in the theater. He was so gentle this time, and the lovemaking was so right, that Arran felt hard-pressed to stay in character. I'm tired, she told herself. How can he carry it off so perfectly? He's a better actor than I remembered.

Afterward, he held her in his arms as they talked softly—he was always willing to talk afterward, unlike most actors, who thought they had to become surly after sex in order to maintain their macho image with the fans.

"That was beautiful," Arran said, and she noticed with alarm that she wasn't acting. Watch yourself, woman. Don't screw up the loop after you've already invested twenty damned days.

"Was it?" Ham asked.

"Didn't you notice?"

He smiled. "After all these years, Arran, and I was right. There's no woman in the world worth loving with you around."

She giggled softly and ducked her head away from him in embarrassment. It was in character, and therefore seductive.

"Then why haven't you come back before?" Arran asked.

And Hamilton rolled over and lay on his back. Because he was silent for a few moments, she rubbed her fingers up and down his stomach. He smiled. "I stayed away, Arran, because I loved you too much."

"Love is never a reason to stay away," she said. Ha. Let the fans quote *that* piece of crap for a couple of years.

"It is," Ham said, "when it's real."

"Even more reason to stay with me!" Arran put on a pout. "You left me, and now you pretend you loved me."

And suddenly Hamilton swung over and sat on the edge of the bed.

"What's wrong?" she asked.

"Damn!" he said. "Forget the stupid act, will you?"

"Act?" she asked.

"The damn Arran Handully character you're wearing for fun and profit! I know you Arran, and I'm telling you—*I'm* telling you, not some actor, *me*—I'm telling you that I love you! Not for the audiences! Not for the loop! For you—I love *you*!"

And with a sickening feeling in the pit of her stomach Arran realized that somehow, that stinking Triuff had gotten Ham to be a dirty trick after all. It was the one outspoken rule in the business—you never, never, never mention the fact that you're acting. For any reason. And now, the ultimate challenge—admitting to the audience that you're an actress and making them still believe you.

"Not for the loop!" she echoed back, struggling to think of some kind of answer.

"I said not for the loop!" He stood

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up and walked away from her, then turned back, pointed at her. "All these stupid affairs, all the phony relationships. Haven't you had enough?"

"Enough? This is life and I'll never have enough of life."

But Ham was determined not to play fair.

"If this is life, Capitol's an asteroid." A clumsy line, not like him. "Do you know what life is Arran? Life is centuries of playing loop after loop, as I've done, screwing every actress who can raise a fee, all so I can make enough money to buy somec and the luxuries of life. And all of a sudden a few years ago, I realized that the luxuries didn't mean a damn thing, and what did I care if I lived forever? Life was so utterly meaningless, just a succession of high-paid tarts!"

Arran managed to squeeze out some tears of rage. The loop never stops. "Are you calling *me* a tart!"

"You?" Ham looked absolutely stricken. The man can act, Arran reminded herself, even as she cursed him for throwing her such a rotten curve. "Not you, Arran, don't even think it!"

"What can I think, with you coming here and accusing me of being a phony!"

"No," he said, sitting beside her on the bed again, putting his arm around her bare shoulder. She nestled to him again, as she had a dozen times before, years ago. She looked up at his face, and saw that his eyes were filled with tears.

"Why are you—why are you crying?" she asked, hesitantly.

"I'm crying for us," he said.

"Why?" she asked. "What do we have to cry over?"

"All the years we've lost."

"I don't know about *you*, but my years have been pretty full," she said, laughing, hoping he would laugh, too.

He didn't. "We were right for each other. Not just as a team of actors, Arran, but as people. You weren't very good back then at the beginning—neither was I. I've looked at the loops. When we were with other people, we were as phony as two-bit beginners. But those loops still sold, made us rich, gave us a chance to learn the trade. Do you know why?"

"I don't agree with your assessment of the past," Arran said coldly, wondering what the hell he was trying to accomplish by continuing to refer to the loops instead of staying in character properly.

"We sold those tapes because of each other. Because we actually looked real when we told each other we loved, when we chattered for hours about nothing. We really enjoyed each other's company."

"I wish I were enjoying your company now. Telling me I'm a phony and then saying I have no talent."

"Talent! What a joke," Ham said. He touched her cheek, gently, turning her face so she would look at him. "Of course you have talent, and so have I. We have money, too, and fame, and everything money can buy. Even friends. But tell me, Arran, how long has it been since you really loved

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anybody? Can you remember?"

Arran thought back through her most recent lovers. Any she wanted to make Ham's character jealous over? No. "I don't think I've ever really loved anybody."

"That's not true," Ham said. "It's not true, you loved me. Centuries ago, Arran, you truly loved me."

"Perhaps," she said. "But what does it have to do with now?"

"Don't you love me now?" Ham asked, and he looked so sincerely concerned that Arran was tempted to break character and laugh with delight, applaud his excellent performance. But the bastard was still making it hard for her, and so she decided to make it hard for him.

"Love you now?" she asked. "You're just another pair of eager gonads, my friend." That'd shock the fans. And, she hoped, completely mess up Ham's nasty little joke.

But Ham stayed right in character. He looked hurt, pulled away from her. "I'm sorry," he said. "I guess I was wrong." And to Arran's shock he began to dress.

"What are you doing?" she asked.

"Leaving," he said.

Leaving, Arran thought with panic. Leaving now? Without letting the scene have a climax? All this buildup, all the shattered traditions, and then leaving without a climax? The man was a monster!

"You can't go!"

"I was wrong. I'm sorry. I've embarrassed myself," he said.

"No, no, Ham, don't leave. I haven't seen you in so long!"

"You've never seen me," he answered. "Or you wouldn't have been capable of saying what you just did."

Making me pay for throwing a curve back at him, Arran thought. I'd like to kill him. What a fantastic actor, though. "I'm sorry I said it," Arran said, wearing contrition as if she had been dipped in it. "Forgive me. I didn't mean it."

"You just want me to stay so I won't ruin your damn scene."

Arran gave up in despair. Why am I doing this, anyway? But the realization that breaking character now would wreck the whole loop kept her going. She went and threw herself on the bed. "That's right!" she said, weeping. "Leave me now, when I want you so much."

Silence. She just lay there. Let him react.

But he said nothing. Just let the pause hang. She couldn't even hear him move.

Finally he spoke. "Do you mean it?"

"Mmm-hmm," she said, managing to hiccough through her tears. A cliche, but it got 'em every time.

"Not as an actress, Arran, please. As yourself. Do you love me? Do you want me?"

She rolled partway onto her side, lifted herself on one elbow, and said, the tears forcing a little catch in her voice, "I need you like I need somec, Ham. Why have you stayed away so long?"

He looked relieved. He walked

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slowly back to her. And everything was peaceful again. They made love four more times, between each course of dinner, and for variety they let the servants watch. I've done it once before, Arran remembered, but it was five loops ago, about, and these are different servants anyway. Of course the servants, underpaid beginning actors all, used it as an excuse to get some interesting onstage time, and turned it into an orgy among themselves, managing every conceivable sexual act in only an hour and a half. Arran barely noticed them, though. They were the kind of fools who thought the audience wanted quantity. If some sex is good, a lot is better, they think. Arran knew better. Tease them. Let them beg. Let them find beauty in it, too, not just titillation, not just lust. That's why she was a star, and they were playing servants in somebody else's loop.

That night Ham and Arran slept in each other's arms.

And in the morning, Arran woke to find Ham staring at her, his face an odd mixture of love and pain. "Ham," she said softly, stroking his cheek. "What do you want?"

The longing in his face only increased. "Marry me," he said softly.

"Do you really mean it?" she asked, in her little-girl voice.

"I mean it. Time our wakings together, always."

"Always is a long time," she said. It was a good all-purpose line.

"And I mean it," he said. "Marry me. Mother knows we've made enough money over the years. We don't ever have to let these other bastards into our lives again. We don't ever have to wear these damned loop recorders again." And as he said that, he patted the recorder strapped to her thigh.

Arran inwardly groaned. He wasn't through with the games yet. Of course the audience wouldn't know what he meant—the computer that created the loop from the loop recorder was programmed to delete the recorder itself from the holo. The audience never saw it. And now Ham was referring to it. What was he trying to do, give her a nervous breakdown? Some friend.

Well, I can play his game. "I won't marry you," she said.

"Please," he said. "Don't you see how I love you? Do you think any of these phonies who pay to make love to you will ever feel one shred of real emotion toward you? To them you're a chance to make money, to make a name for themselves, to strike it rich. But I don't need money. I have a name. All I want is you. And all I can give you is me."

"Sweet," she said, coldly, and got up and went to the kitchen. The clock said eleven thirty. They had slept late. She was relieved. At noon she had to leave to get to the Sleeproom. In a half hour this farce would be over. Now to build it to a climax.

"Arran," Ham said, following her. "Arran, I'm serious. I'm not in character!"

That much is obvious, Arran thought but did not say.

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"You're a liar," she said, rudely.

He looked puzzled. "Why should I lie? Haven't I made it plain to you that I'm telling the truth? That I'm not acting?"

"Not acting," she said, sneering (but seductively, seductively. Never out of character, she reminded herself), and she turned her back to him. "Not acting. Well, as long as we're being honest about things, and throwing away both pretense and art, I'll play it your way, too. Do you know what I think of you?"

"What?" he asked.

"I think this is the cheapest, dirtiest trick I've ever seen. Coming here like this, doing everything you could to lead me into thinking you loved me, when all the time you were just exploiting me. Worse than all the others! You're the worst!"

He looked stricken. "I'd never exploit you!" he said.

"Marry me!" Arran laughed, mocking him. "Marry me, says you, and then what? What if this poor little girl actually did marry you? What would you do? Force me to stay in the flat forever? Keep away all my other friends, all my others—yes, even my lovers, you'd make me give them all up! Hundreds of men love me, but you, Hamilton, you want to own me forever exclusively! What a coup that would be, wouldn't it? No one would ever get to look at my body again," she said, moving her body in such a way that no one in the world could possibly want to look anywhere else, "except you. And you say you don't want to exploit me. How can I believe you?"

Hamilton came closer to her, tried to touch her, tried to plead with her, but she only grew angry, cursed him. "Stay away from me!" she screamed.

"Arran, you can't mean it," Ham said, softly.

"I have never meant anything more thoroughly in my life," she said.

He looked in her eyes, looked deep. And finally he spoke again. "Either you're so much an actress that the real Arran Handully is lost, or you really do mean that. And either way, there's nothing for me to stay here for." And Arran watched admiringly as Hamilton gathered up his clothing, and not even bothering to dress, he left, closing the door quietly before him. A beautiful exit, Arran thought. A lesser actor couldn't have resisted the temptation to say one last line. But not Ham—and now, if Arran played it right, this grotesque scene could be, after all, a genuine climax to the loop.

And so she played the scene, at first muttering about what a terrible man Ham was, and then progressing quickly to wondering whether he'd ever come back. "I hope he does," she said, and soon was weeping, crying out that she couldn't live without him. "Please come back, Ham!" she said pitifully. "I'm sorry I refused you! I *want* to marry you."

But then she looked at the clock. Nearly noon. Thank Mother. "But it's time," she said. "Time to go to the Sleeproom. The Sleeproom!" New hope came into her voice. "That's it!

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I'll go to the Sleeproom. I'll let the years pass by, and when I wake, there he'll be, waiting for me!" She rhapsodized for a few more minutes, then threw a robe around herself and ran lightly, eagerly down the corridors to the Sleeproom.

In the tape-and-tap she chattered gaily to the attendant. "He'll be there waiting for me," she said, smiling. "Everything will be all right." The sleep helmet went on, and Arran kept talking. "You do think there's hope for me, don't you?" she asked, and the woman whose soft hands were now removing the helmet answered, "There's always hope, ma'am. Everybody has hope."

Arran smiled, then got up and walked briskly to the sleep table. She didn't remember ever doing this before, though she knew she must have—and then it occurred to her that *this* time she could watch the actual loop, see what really happened to her when the somec entered her veins.

But because she didn't remember any other administration of somec, she didn't realize the difference when the attendant gently put a needle only a millimeter under the surface of the palm of her skin. "It's so sharp," Arran said, "but I'm glad it doesn't hurt." And instead of the hot pain of somec, a gentle drowsiness filled her, and she was whispering Ham's name as she drifted off to sleep. Whispering his name, but silently cursing him under her breath. He may be a great actor, she told herself, but I ought to kick his head through a garbage chute for giving me a rotten time like that. Oh well. It'll sell seats in the theaters. Yawn. And then she slept.

The loop continued for a few more minutes, as the attendants went through a mumbo-jumbo of nonsensical, meaningless activities. And finally they stepped back as if they were through, Arran's nude body lying on the table. Pause for the loop recorder to take the ending, and then:

A buzzer, and the door opened and Triuff came in, laughing in glee. "What a loop," she said, as she unstrapped the recorder from Arran's leg.

When Triuff had gone, the attendants put the real needle in Arran's arm, and the heat poured through her veins. Asleep though she had already been, Arran cried out in agony, and the sweat drenched the table in only a few minutes. It was ugly, painful, frightening. It just wouldn't do to have the masses see what somec was *really* like. Let them think the sleep is gentle; let them think the dreams are sweet.

When Arran woke, her first thought was to find out if the loop had *worked*. She had certainly gone through enough effort—now to see if Triuff's predictions of retirement had been fulfilled.

They had been.

Triuff was waiting right outside the Sleeproom, and hugged Arran tightly. "Arran, you wouldn't believe it!" she said, laughing uproariously. "Your last three loops had already set re-

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cords the highest-grossing loops of all time. But this one! This one!"

"Well?" Arran demanded.

"More than three times the total of those three loops put together!"

Arran smiled. "Then I can retire?"

"Only if you want to," Triuff said. "I have several pretty good deals worked out—"

"Forget it," Arran said.

"They wouldn't take much work, only a few days each—"

"I said forget it. From now on I never strap another recorder to my leg again. I'll guest. But I won't record."

"Fine, fine," Triuff said. "I told them, but they made me promise to ask you anyway."

"And probably paid you a pretty penny, too," Arran answered. Triuff shrugged and smiled.

"You're the greatest ever," Triuff said. "No one has ever done so well as you."

Arran shook her head. "Might be true," she said, "but I was really sweating it. That was a rotten trick you pulled on me, having Ham break character like that."

Triuff shook her head. "No, no, not at all, Arran. That must have been *his* idea. I told him to threaten to kill you—a real climax, you know. And then he went in and did what he did. Well, no harm done. It's an exquisite scene, and *because* he broke character—and you, too, there at the end—the audience believed that it *was* real. Beautiful. Of course, everybody and his duck is breaking character now, but it doesn't work anymore. Everyone knows it's just another device. But the first time, with you and Ham—" and Triuff made an expansive gesture "—it was magnificent."

Arran led the way down the corridor. "Well, I'm glad it worked. But I'm still looking forward to a chance to rake Ham over the coals for it."

"Oh, Arran, I'm sorry," Triuff said.

Arran stopped and faced her manager. "For what?"

Triuff actually looked sad. "Arran, it's Hamilton. Not even a week after you went under—it was the saddest thing. Everybody talked about it for days."

"What! Did something happen to him?"

"He hung himself. Turned off the lights in his flat so none of the watchers could see him, and hung himself from a light fixture with a bathrobe tie. He died right away, no chance to revive him. It was terrible."

Arran was surprised to find a lump in her throat. A real one. "Ham's dead," she said softly. She remembered all the scenes they had played together, and a real fondness for him came over her. I'm not even acting, she realized. I truly cared for the man. Sweet, wonderful Ham.

"Does anyone know why he did it?" Arran asked.

Triuff shook her head. "No one has the slightest idea. And the thing I just can't believe—there it was, a scene they've never had before in a loop, a real suicide. And he didn't even record it!" ■

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STARDANCE II

Living in a new environment is always a challenge. What you don't know can kill you—very quickly.

Spider and Jeanne Robinson

PART TWO OF THREE PARTS

SYNOPSIS

Unable to achieve artistic recognition on Earth, Shara Drummond had come to space, to the orbiting industrial complex of Skyfac Incorporated to become the first zero gravity dancer. There she died—for a body acclimates to free fall irrevocably—*but not before she served as a kind of interpreter between mankind and a swarm of apparently aggressive aliens from deep space, who communicated by the universal language: dance. The oft-imagined First Contact turned out to be essentially a "duel of dance"—which Shara's* Stardance *had won, driving the aliens from Earth's orbit and beyond territorial detection. Drained by the combat and unable to return to the planet she had saved, Shara perished in flames in the upper stratosphere.*

She was survived by her older sister, Norrey, and by me: Charlie Armstead, Shara's video man. I taped the Stardance, *and when that tape became the most wildly acclaimed artistic event of the century, Norrey and I (who had been good friends and occasional lovers for over twenty years) used the profits to establish* The Stardancers, *a zero gee dance company, in Shara's memory. With Tom McGillicuddy, a former Skyfac exec turned dancer, and Linda Parsons, a wise and empathic young dancer from a commune background, we created the new kind of dance as Shara had envisioned it, in an orbiting dance/video studio designed and built by Harry Stein (the most experienced free-fall engineer alive), with sets, lighting and music created by Raoul Brindle, a thin, bespectacled genius. We all divided our time between taping zero gee dance for commercial release and attempting to train new dancers for our company.*

We experienced enormous and unexpected difficulty with the latter: for as we slowly learned, the ability to function without a clearly defined

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"up" and "down," without a "local vertical," is an extremely rare and unpredictable talent. Perhaps fewer than one in a hundred can ever learn to perceive spherically, *to coordinate in the absence of a linear perceptual set. It is not weightlessness per se that is the problem: Skyfac personnel function in low or no gee—so long as they have an environment of right angles, an arbitrary "up" and "down." But in free space, most people become hopelessly disoriented and panic-stricken.*

But the six of us were among the rare ones who could live without a local vertical. We lived contentedly in free fall, inventing new artistic methods as we went along, and acquiring spiritual grounding and insight from the daily contemplation of infinity inherent in space life. I began to lose the armor of cynicism, the perpetual bitterness I had been steeped in ever since (in my early twenties) a burglar's bullet had smashed both my right hip and my potentially brilliant career as a conventional Modern dancer (my gimp leg was quite adequate for zero gee). Norrey and I got married. Tom and Linda became lovers. The whole company became a true family, as we came to realize that free fall dance requires something like mutual telepathy. The tension which, in normal dance, is provided by gravity, must in space be provided by each other*—forcing us to become as attuned to one another as acrobats, constantly solving at least four-body-problems in our heads and outguessing each other's next moves.*

Then one day we were running through a new piece on the Monkey Bars, a kind of neon-lit 3D gymnasts' jungle, located (for an uncluttered visual background) many kilometers distant from our home Studio complex. The piece was fast and complex, and I was distracted by deadline worries: very soon we would have to make our yearly pilgrimage to Earth for six months' enforced vacation, so that our bodies would not complete their adaptation to zero gee and maroon us in orbit. Because I was brooding about deadlines, I made that one fatal error, triggered the wrong thruster unit and smacked backwards hard into Tom, blowing one of my air-tanks, shooting clear of the Monkey Bars, and went speeding toward deep space . . .

Happening to smack into the Bars off center was a break. It put me into an acrobat's tumble, which centrifuged air into my hood and boots, and blood to my head and feet, bringing me out of blackout quicker. Even so, precious seconds ticked by while I groggily deduced my problem, picked my point and began to spin correctly. With the perspective that gave me I oriented myself, still groggy, figured out intuitively which thrusters would kill the spin, and used them.

That done, it was easy to locate the Bars, a bright cubist's Christmas tree growing perceptibly smaller as I watched. It was between me and the blue beachball I'd been born on. At

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least life would not be corny enough to award me Shara's death. But Bryce Carrington's didn't appeal to me much more.

My thighs ached like hell, the right one especially, but my spine hadn't begun to hurt yet—I hadn't yet worked out that it ought to. There were voices in my headphones, urgent ones, but I was still too fuzzy to make any sense out of what they were saying. Later I could spare time to retune my ears; right now figures were clicking away in my mind and the answers kept getting worse. There's much more pressure in an air tank than in a thruster. On the other hand, I had ten aimable thrusters with which to cancel the velocity imparted by that one diffused burst. On the third hand, I had started this with badly depleted thrusters.

Even as I concluded that I was dead I was doing what I could to save my life: one by one I lined up my thrusters on the far side of my center of mass and fired them to exhaustion. Left foot, fore and aft. Right foot, likewise. Belly thruster. My back began to moan, then cry, then shriek with agony, not the localized knifing I'd expected but a general ache. I couldn't decide if that were a good sign or bad. Back thruster, clamping my teeth against a whimper. Left hand, fore and aft.

save a little. I reserved my right hand pair for last minute maneuvers, and looked to see if I'd done any good.

The Monkey Bars were still shrinking, at a fairly rapid pace.

I was almost fully conscious now, feeling that my brains were just catching up with me. The voices in my headphones began to make sense at last. The first one that I identified, of course, was Norrey's—but she wasn't saying anything, only crying and swearing.

"Hey, honey," I said as calmly as I could, and she cut off instantly. So did the others. Then—

"Hang on, darling. *I'm coming!*"

"That's right, boss," Harry agreed. "I've been tracking you with the radar gun since you left, and the computer's doing the piloting."

"She'll get you," Raoul cried. "The machine says yes. With available fuel, it can get her to you and then back here, Charlie, it says yes."

Sure enough, just to the side of the Bars I could see the family car, nose-on to me. It was not shrinking as fast as the Bars were—but it did appear to be shrinking. That had been a hell of a clout that can of air fetched me.

"Boss," Harry said urgently, "*is your suit honest?*"

"Yeah, sure, the force of the blast was outwards, didn't even damage the other can." My back throbbed just thinking about it, and yes, damn it, the car's visible disk was definitely shrinking, not a whole lot but certainly *not* growing, and at that moment of moments I recalled that the warranty on that computer's software had expired three days ago.

Say something heroic before you moan.

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"Well, that's settled," I said cheerfully. "Remind me to sue the bas—hey! *How's Tom?"*

"We got it patched," Harry said briefly. "He's out, but telemetry says he's alive and okay."

No wonder Linda was silent. She was praying.

"Is there a doctor in the house?" I asked rhetorically.

"I called Skyfac. Panzarella's on his way. We're proceeding home on thrustérs to get Tom indoors now."

"Go, all three of you. Nothing you can do out here. Raoul, take care of Linda."

"Yah."

Silence fell, except of course for the till now unheard constants of breathing and rustling cloth. Norrey began to cry again, briefly, but controlled it. The disc that was her and the car was growing now; I had to stare and measure with my thumb but yes, it was growing.

"Attaway, Norrey, you're gaining on me," I said, trying to keep it light.

"That I am," she agreed, and when the *rate* of the car's growth had just reached a visibly perceptible crawl, the corona of her drive winked out. "What the—?"

Visualize the geometry. I leave the Monkey Bars at a hell of a clip. Maybe a full thirty seconds elapse before Norrey is in the saddle and blasting. Ideally the computer has her blast to a velocity higher than mine, hold it, then turnover and begin decelerating so that she will begin to return toward the Bars *just as our courses intersect.* A bit tricky to work out in your head, but no problem for a ballistic computer half as good as ours.

The kicker was fuel.

Norrey *had to* cut thrust precisely halfway through projected total fuel consumption. She had used up half the content of her fuel tanks; the computer saw that at these rates of travel rendezvous could be accomplished eventually; it cut thrust with a computer's equivalent of a smile of triumph. I did primitive mental arithmetic, based on guesswork and with enormous margins for error, and went pale and cold inside my plastic bag.

The second kicker was air.

"Harry," I rapped, "run that projection through again for me, but include the following air supply data—"

"Oh Jesus God," he said, stunned, and then repeated back the figures I gave him. "Hold on."

"Charlie," Norrey began worriedly. "Oh my God, Charlie!"

"Wait, baby. Wait. Maybe it's okay."

Harry's voice was final. "No good, boss. You'll be out of air when she gets there. She'll be damn low when she gets back."

"Then turn around and start back now, hon," I said as gently as I could.

"Hell no," she cried.

"Why risk your neck, darling? *I'm already buried*—buried in space. Come on now—"

"No."

I tried brutality. "You want my corpse that bad?"

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"Yes."

"Why, to have it hanging around the closet?"

"No. To ride with."

"Huh?"

"Harry, plot me a course that'll get me to him before his air runs out. Forget the round trip: give me a minimum-time rendezvous."

"No!" I thundered.

"Norrey," Harry said earnestly, "there's *nothing else to come get you with*. There's not a ship in the sky. You blast any more and you'll never even get started back here, you'll never even stop leaving. You've got more air than him, but both your air combined wouldn't last one of you 'til help could arrive, even if we could keep tracking you that long." It was the longest speech I'd ever heard Harry make.

"I'm damned if I want to be a widow," she blazed, and cut in acceleration on manual override.

She was as dead as me, now.

"Goddammit," Harry and I roared together, and then "Help her, Harry!" I screamed, and "I am!" he screamed back and an endless time later he said sadly, "Okay, Norrey, let go. The new course is locked in." She was still dead, had been from the moment she overrode the computer. But at least now we'd go together.

"All right, then," she said, still angry but mollified. "Twenty-five years I waited to be your wife, Armstead. I will be *damned* if I'll be your widow."

"Harry," I said, knowing it was hopeless but refusing to accept, "refigure, assuming that we leave the car when it runs out of juice and use all of Norrey's suit thrusters together. Hers aren't as low as mine were."

It must have been damned awkward for Harry, using two fingers to keep himself headed for home at max thrust, holding the big computer terminal and pushing keys with the rest. It must have been more awkward for Raoul and Linda, towing the unconscious Tom between them, watching their patch job leak.

"Forget it, boss," Harry said almost at once. "There's two of you."

"Well then," I said desperately, "can we trade off breathing air for thrust?"

He must have been just as desperate; he actually worked the problem. "Sure. You could start returning, get back here in less than a day. But it'd take *all* your air to do it. You're dead, boss."

I nodded, a silly habit I'd thought I'd outgrown. "That's what I thought. Thanks, Harry. Good luck with Tom."

Norrey said not a word. Presently the computer shut down her drive again, having done its level best to get her to me quickly with the fuel available. The glow around the car (now plainly growing) winked out, and still she was silent. We were all silent. There was either nothing to say or too much, no in-between. Presently Harry reported docking at home. He gave Norrey her turnover data, gave her back manual control, and then he and

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the others went off the air.

Two people breathing makes hardly any noise at all.

She was a long long time coming, long enough for the pain in my back to diminish to the merely incredible. When she was near enough to see, it took all my discipline to keep from using the last of my jump-juice to try and match up with her. Not that I had anything to save it for. But matching in free space is like high speed highway merging—one of you had better maintain a constant velocity, two variables is too many. Norrey did a textbook job, coming to a dead stop relative to me at the extreme edge of lifeline range.

The precision was wasted. But you don't stop trying to live just because a computer says you can't.

At the same split second that she stopped decelerating she fired the lifeline. The weight at the end tapped me gently on the chest: *very* impressive shooting, even with the magnet to help. I embraced it fiercely, and it took me several seconds of concentrated effort to let go and clip it to my belt. I hadn't realized how lonely and scared I was.

As soon as she was sure I was secure, she cut the drag and let the car reel me in.

"Who says you can never get a cab when you need one?" I said, but my teeth were chattering and it spoiled the effect.

She grinned anyhow, and helped me into the rear saddle. "Where to, Mac?"

All of a sudden I couldn't think of anything funny to say. If the car's fuselage hadn't been reinforced, I'd have crushed it between my knees. "Wherever you're going," I said simply, and she spun around in her saddle and gave it the gun.

It takes a really sensitive hand to pilot a tractor like the family car accurately, especially with a load on. It's quite difficult to keep the target bubble centered, and the controls are mushy—you have to sort of outguess her or you'll end up oscillating and throw your gyro. A dancer is, of course, better at seat-of-the-pants mass balancing than any but the most experienced of Space Command pilots, and Norrey was the best of the six of us. At that she outdid herself.

She even outdid the computer. Which is not too astonishing—there's always more gas than it says on the gauge—and of course it wasn't nearly enough to matter. We were still dead. But after a time the distant red and green spheroid that was the Bars stopped shrinking; instruments confirmed it. After a longer time I was able to convince myself that it was actually growing some. It was, naturally, at that moment that the vibration between my thighs ceased.

All the time we'd been accelerating I'd been boiling over with the need to talk, and had kept my mouth shut for fear of distracting Norrey's attention. Now we had done all we could do. Now we had nothing left to do in our lives but talk, and I was wordless again. It was Norrey who broke the

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silence, her tone just precisely right.

"Uh, you're not going to believe this . . . but we're out of gas."

"The hell you say. Let me out of this car; I'm not that kind of boy." *Thank you, hon.*

"Aw, take it easy. It's downhill from here. I'll just put her in neutral and we'll coast home."

"Hey listen," I said, "when you navigate by the seat of your pants like that, is that what they call a bum steer?"

"Oh Charlie, I don't want to die."

"Well then, don't."

"I wasn't *finished* yet."

"Norrey!" I grabbed her shoulder from behind. Fortunately I used my left hand, triggering only empty thrusters.

There was a silence.

"I'm sorry," she said at last, still facing away from me. "I made my choice. These last minutes with you are worth what I paid for them. That just slipped out." She snorted at herself. "Wasting air."

"I can't think of anything I'd rather spend air on than talking with you. That you can do in p-suits, I mean. I don't want to die either—but if I've got to go, I'm glad I've got your company. Isn't that selfish?"

"Nope. I'm glad you're here too, Charlie."

"Hell, I *called* this meeting. If I wasn't here, nobody would be." I broke off then, and scowled. "That's the part that bothers me the most, I think. I used to try and guess, sometimes, what it would be that would finally kill me. Sure enough, I was right; my own damn stupidity. Spacing out. Taking my finger off the number. Oh dammit, Norrey—"

"Charlie, it was an accident."

"I spaced out. I wasn't paying attention. I was thinking about the goddamned fucking deadline, and I blew it." (I was very close to something, then; something bigger than my death.)

"Charlie, that's cheating. At least half of that guilt you're hogging belongs to the crook that inspected that air tank at the factory. Not to mention the flaming idiot who forgot to gas the car this morning."

It's a rotating duty. "Who was that idiot?" I asked, before I could think better of it.

"Same idiot who took off without grabbing extra air. Me."

That produced an uncomfortable silence. Which started me trying to think of something meaningful or useful to say. Or do. Let's see, I had less than an eighth of a can of air. Norrey maybe a can and a quarter: she hadn't used up as much in exercise. (Space Command armor, like the NASA Standard suits before them, hold about six hours' air. A Stardancer's p-suit is good for only half as much—but they're prettier. And we *always* have plenty of air bottles—strapped to every camera we use.) I reached forward and unshipped her full tank, passed it silently over her shoulder. She took it, as silently, and got the first aid kit out of the glove compartment. She took a Y-joint from it,

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made sure both male ends were sealed and snapped it onto the air bottle. She got extension hoses from the kit and mated them to the ends of the Y. She clipped the whole assembly to the flank of the car until we needed it, an air soda with two straws. Then she reversed herself in the saddle, awkwardly, until she was facing me.

"I love you, Charlie."

"I love you, Norrey."

Don't ever let anybody tell you that hugging in p-suits is a waste of time. Hugging is *never* a waste of time. It hurt my back a lot, but I paid no attention.

The headphones crackled with another carrier wave: Raoul calling from Tom and Linda's place. "Norrey? Charlie? Tom's okay," he said agitatedly. "I mean, he's a mess, but he's okay. The doctor's on his way, Charlie, but he's not going to get here in time to do you any good. I called the Space Command, there's no scheduled traffic *near* here, there's just nothing in the neighborhood, Charlie, just nothing at all, what the hell are we going to *do*?" Harry must have been very busy with Tom, or he'd have grabbed the mike by now.

"Here's what you're going to do, buddy," I said calmly, spacing my words to slow him down. "Push the record button. Okay? Now put the speakers on so Harry and Linda can witness. Ready? Okay. 'I, Charles Armstead, being of sound mind and body—' "

"Charlie!"

"Don't spoil the tape, buddy. I haven't got time for too many retakes, and I've got better things to do. 'I, Charles Armstead—' "

It didn't take very long. I left everything to the company—and I made Fat Humphrey a full partner. Le Maintenant had closed the month before, strangled by bureaucracy. Then it was Norrey's turn, and she echoed me almost verbatim.

What was there to do then? We said our good-byes to Raoul, to Linda, and to Harry, making it as short as possible. Raoul cried. Linda was grave, solemn. Harry was brief. Then we switched off our radios. Sitting backwards in the saddle was uncomfortable for Norrey; she turned around again and I hugged her from behind like a motorcycle passenger. Our hoods touched. What we said then is really none of your damned business.

An hour went by, the fullest hour I had ever known. All infinity stretched around us. Being both ignorant of astronomy, we had given names of our own to the constellations on our honeymoon. The Banjo. The Leering Gerbil. Orion's Truss. The Big Pot Pipe and the Little Hash Pipe. One triplet near the Milky Way that quite naturally became the Three Musketeers. Like that. We renamed them all, now, re-evoking that honeymoon. We talked of our lost plans and hopes. In turns, we freaked out and comforted each other, and then we both freaked out together and both comforted each other. We told each other those last few secrets even happily marrieds hold out. Twice, we agreed to take off our

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p-suits and get it over with. Twice, we changed our minds. We talked about the children we didn't have, and how lucky it was for them that we didn't have them. We sucked our sugar water from our hood nipples. We talked about God, about death, about how uncomfortable we were, and how absurd it was to die uncomfortable—about how absurd it was to die at all.

"It was deadline pressure killed us," I said finally. "stupid damned deadline pressure. In a big hurry. Why? So we wouldn't get marooned in space by our metabolisms. What was so wrong with that?" (I was very close, now.) "What were we so scared of? What has Earth got, that we were risking our necks to keep?"

"People," Norrey answered seriously. "Places. There aren't many of either up here."

"Yeah, places. New York. Toronto. Cesspools."

"Not fair. Prince Edward Island."

"Yeah, and how much time did we get to spend there? And how long before *it's* a bloody city?"

"*People*, Charlie. Good people."

"Seven billion of 'em, squatting on the same disintegrating anthill."

"Charlie, look out there." She pointed to the Earth. "Do you see an oasis hanging in space? Does that look crowded to you?"

She had me there. From space, one's overwhelming impression of our home planet is of one vast, godforsaken wilderness. Desert is by far the most common sight, and only occasionally does a twinkle or a miniature mosaic give evidence of human works. Man may have polluted hell out of his atmosphere—seen edge-on at sunset it looks no thicker than the skin on an apple—but he has as yet made next to no visible mark on the face of his planet.

"No. But it is, and you know it. My leg hurts all the time. There's never a moment of real silence. It stinks. It's filthy and germ-ridden and riddled with evil and steeped in contagious insanity and hip deep in despair. I don't know what the hell I ever wanted to go back there for."

"Charlie!" I only realized how high my volume had become when I discovered how loud she had to be to outshout me. I broke off, furious with myself. *Again you want to freak out? The last time wasn't bad enough?*

I'm sorry, I answered myself, *I've never died before. I undersand it's been done worse.* "I'm sorry, hon," I said aloud. "I guess I just haven't cared much for Earth since Le Maintenant closed." It started out to be a wisecrack, but it didn't come out funny.

"Charlie," she said, her voice strange.

You see! There she *goes now, and we're off and running again.* "Yeah?"

"Why are the Monkey Bars blinking on and off?"

At once I checked the air-bottle, then the Y-joint, hoses, and joins. No, she was getting air. I looked then, and sure as hell the Monkey Bars were blinking on and off in the far distance,

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a Christmas tree bulb on a flasher circuit. I checked the air again, carefully, to make sure we weren't both hallucinating, and returned to our spoon embrace.

"Funny," I said, "I can't think of a circuit malf that'd behave that way."

"Something must have struck the sunpower screen and set it spinning," she said.

"I guess. But what?"

"The hell with it, Charlie. Maybe it's Raoul trying to signal us."

"If it is, to hell with him indeed. There's nothing more I want to say, and I'm damned if there's anything I want to hear. Leave the damn phone off the hook. Where were we?"

"Deciding Earth sucks."

"It certainly does—hard. Why does *anybody* live there, Norrey? Oh, the hell with that too."

"Yeah. It can't be such a bad place. We met there."

"That's true." I hugged her a little tighter. "I guess we're lucky people. We each found our other half. And before we died, too. How many are that lucky?"

"Tom and Linda, I think. Diane and Howard in Toronto. I can't think of anybody else I know of, for sure."

"Me either. There used to be more happy marriages around when I was a kid." The Bars began blinking twice as fast. A second improbable meteor? Or a chunk of the panel breaking loose, putting the rest in a tighter spin? It was an annoying distraction; I moved until I couldn't see it. "I guess I never realized just how incredibly lucky we are. A life with you in it is a square deal."

"Oh, Charlie," she cried, moving in my arms. Despite the awkwardness she worked around in her saddle to hug me again. My p-suit dug into my neck, the earphone on that side notched my ear, and her strong dancer's arms raised hell with my throbbing back, but I made no complaint. Until her grip suddenly convulsed even tighter.

"*Charlie!*"

"Nnngh."

She relaxed her clutch some, but held on. "What the hell is that?"

I caught my breath. "What the hell is what?" I twisted in my seat to look. "*What the hell is that*?" We both lost our seats on the car and drifted to the ends of our hoses, literally stunned.

It was practically on top of us, within a hundred meters, so impossibly enormous and foreshortened that it took us seconds to recognize, identify it as a ship. My first thought was that a whale had come to visit.

Champion, said the bold red letters across the prow. And beneath, *United Nations Space Command*.

I glanced back at Norrey, then checked the air line one more time. "No scheduled traffic," I said hollowly, and switched on my radio.

The voice was incredibly loud, but the static was so much louder that I knew it was off-mike, talking to someone in the same room. I remember every syllable.

". . . pid humping idiots are too goddamned dumb to turn on their

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radios, sir. Somebody's gonna have to tap 'em on the shoulder."

Further off-mike, a familiar voice began to laugh like hell, and after a moment the radioman joined in. Norrey and I listened to the laughter, speechless. A part of me considered laughing too, but decided I might never stop.

"Jesus Christ," I said finally. "How far does a man have to go to have a little privacy with his wife?"

Startled silence, and then the mike was seized and the familiar voice roared. "You son of a bitch!"

"But seeing you've come all this way, Major Cox," Norrey said magnificently, "we'll come in for a beer."

"You dumb son of a bitch," Harry's voice came from afar. "You dumb son of a bitch." The Monkey Bars had stopped winking. We had the message.

"After you, my love," I said, unshipping the air tank, and as I reached the airlock my last thruster died. Bill Cox met us at the airlock with three beers, and mine was *delicious*.

The two sips I got before the fun started.

Like Phillip Nolan, I had renounced something out loud—and had been heard.

CHAPTER FIVE

I took those two sips right away, and made them last. Officers and crew were frankly gaping at Norrey and me. At first I naturally assumed they were awed by anyone dumb enough to turn off their radios in an emergency. Well, I hadn't thought of being dead as an emergency. But on the second sip I noticed a certain subtle classification of gaping. With one or two exceptions, all the female crew were gaping at me and all the male crew were gaping at Norrey. I had not exactly forgotten what we were wearing under our p-suits; there was almost nothing to forget. We were "decently" covered by sanitary arrangements, but just barely, and what is commonplace on a home video screen on Earth is not so in the ready room of a warship.

Bill, of course, was too much of a gentleman to notice. Or maybe he realized there was not one practical thing to do about the situation except ignore it. "So reports of your demise were exaggerated, eh?"

"On the contrary," I said, wiping my chin with my glove. "They omitted our resurrection. Which by me is the most important part. Thanks, Bill."

He grinned, and said a strange thing very quickly. "Don't ask any of the obvious questions." As he said it, his eyes flickered slightly. On Earth or under acceleration they would have flicked from side to side. In free fall, a new reflex controls, and he happened to be oriented out of phase to my local vertical: his pupils described twin circles, perhaps a centimeter in diameter, and returned to us. The message was plain. The answers to my obvious next questions were classified information. Wait.

Hmmm.

I squeezed Norrey's hand hard—unnecessarily, of course—and groped

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for a harmless response.

"We're at your disposal," is what I came up with.

He flinched. Then in a split second he decided that I didn't mean whatever he'd thought I meant, and his grin returned. "You'll want a shower and some food. Follow me to my quarters."

"For a shower," Norrey said, "I will follow you through hell." We kicked off.

There was my second chance to gawk like a tourist at the innards of a genuine warship. (The first had come just before Shara's *Stardance*, when Bill was supposed to be taking Shara back to Earth.) Did Bill really expect his crew to believe that he had just happened to pick us up hitchhiking? Whenever no one was visibly within earshort, I tried to pump him—but in Space Command warships, the air pressure is so low that sounds travel poorly. He outflew my questions—and how much expression does a man wear on the soles of his feet?

At last we reached his quarters and swung inside. He backed up to a wall and hung facing us, in the totally relaxed "spaceman's crouch," and tossed us a couple of odd widgets. I examined mine: it looked like a wristwatch with a miniature hair-dryer attached. Then he tossed us a pair of cigarettes and I got it. Mass priorities in military craft differ from those of essentially luxury operations like ours or Skyfac's: the *Champion*'s air-system was primitive, not only low-pressure but inefficient. The widgets were combination air-cleaner/ashtrays. I slipped mine over my wrist and lit up.

"Major William Cox," I said formally, "Norrey Armstead. Vice Versa."

It is of course impossible to bow when your shoulders are velcro'd to the wall, but Bill managed to signify. Norrey gave him what we call the free fall curtsy, a movement we worked out idly one day on the theory that we might someday give curtain calls to a live audience. It's indescribable but spectacular, as frankly sexual as a curtsy and as graceful.

Bill blinked, but recovered. "I am honored, Ms. Armstead. I've seen all the tapes you've released, and—well, this will be easy to misunderstand, but you're her sister."

Norrey smiled. "Thank you, Major—"

"Bill."

"—Bill. That's high praise. Charlie's told me a lot about you."

"Likewise, one drunken night when we met dirtside. Afterwards."

I remembered the night—weeks before I had consciously realized that I was in love with Norrey—but not the conversation. My subconscious tells me only what it thinks I ought to know.

"Now you must both forgive me," he went on, and I noticed for the first time that he was in a hurry. "I'd like nothing better than to chat, but I can't. Please get out of your p-suits, quickly."

"Even more than a shower, I'd like

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some answers, Bill." I said. "What the hell brings you out our way, just in the nicotine? Like that. I don't believe in miracles, not that kind anyway. And why the hush?"

"Yes," Norrey chimed in, "and why didn't your own ground control know you were in the area?"

Cox held up both hands. "Whoa. The answer to your questions runs about twenty minutes minimum. In—" he glanced at his watch, "less than three we accelerate at two gravities. That's why I want you out of those suits—my bed *will* accommodate air tank fittings, but you'd be uncomfortable as hell."

"What? Bill, what the *hell* are you talking about? Accelerate where? Home is a couple o' dozen klicks thataway."

"Your friends will be picked up by the same shuttle that is fetching Dr. Panzarella," Cox said. "They'll join us at Skyfac in a matter of hours. But you two can't wait."

"For *what*?" I hollered.

Bill arm wrestled me with his eyes, and lost. "Damn it," he said, and paused. "I have specific orders not to tell you a thing." He glanced at his chronometer. "And I really do have to get back to the worry hole. Look, if you'll trust me and pay attention, I can give you the whole twenty minutes in two sentences, all right?"

"I—yeah. Okay."

"The aliens have been sighted again, in the close vicinity of Saturn. They're just sitting there. Think it through."

He left at once, but before he cleared the doorway I was halfway out of my p-suit, and Norrey was reaching for the straps on the right half of the Captain's couch.

And we were both beginning to be terrified. Again.

Think it through, Bill had said.

The aliens had come boldly knocking on our door once, and been met by a shotgun blast named Shara. They were learning country manners; this time they had stopped at the fence gate, shouted "hello" and waited prudently. (Saturn was just about our fence gate, too—as I recalled, a manned expedition to Saturn was being planned at that time, for the usual obscure scientific reasons.) Clearly, they wanted to parley.

Okay, then: if you were the secretary general, who would *you* send to parley? The Space Commando? Prominent politicians? Noted scientists? A convention of used copter salesmen? You'd most likely send your most seasoned and flexible career diplomats, of course, as many as could go.

But would you omit the only artists in human space who have demonstrated a working knowledge of pidgin Alien?

I was drafted—at my age.

But that was only the first step in the logic chain. The reason that Saturn probe story had made enough of a media splash to attract even my attention was that it was a kind of kamikaze mission for the crew. Whose place we

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were about to be assuming.

Think it through. Whatever they planned to send us to Saturn on, it was sure to take a *long* time. Six years was the figure I vaguely recalled hearing mentioned. And any transit over that kind of distance would have to be spent almost entirely in free fall. You could rotate the craft to provide gravity at either end—but one gee's worth of rotation of a space that small would create so much Coriolis differential that anyone who didn't want to puke or pass out would have to stay lying down for six years. Or hang like bolos from exercise lines on either end—not much more practical.

If we didn't dodge the draft, we would never walk Earth again. We would be free fall exiles, marooned in space. Our reward for serving as mouthpieces between a bunch of idiot diplomats and the things that had killed Shara.

Assuming that we survived the experience at all.

At any other time, the implications would have been too staggering for my brain to let itself comprehend; my mind would have run round in frightened circles. Unless I could talk my way out of this with whoever was waiting for us at Skyfac (why Skyfac?), Norrey and I had taken our last walk, seen our last beach, gone to our last concert. We would never again breath uncanned air, eat with a fork, get rained on or eat fresh food. We were dead to the world (*S.I.C. TRANSIT: gloria mundi*, whispered a phantom memory, that had been funny enough the first time). And yet I faced it squarely, calmly.

Not more than an hour ago I had renounced all those things.

And resigned myself to the loss of a lot of more important things, that it looked like I was now going to be able to keep. Breathing. Eating. Sleeping. Thinking. Making love. Hurting. Scratching. Bowel movements. Bitching. Why, the list was endless—and I had all those things back, at least six years' worth! Hell, I told myself, there were damned few city dwellers any better off—few of *them* ever got walks, beaches, concerts, uncanned air or fresh food. What with airlocks and nostril filters, city folk might as well be in orbit for all the outdoors they could enjoy—and how many of them could feel confident of six more years? I couldn't begin to envision the trip to Saturn, let alone what lay at the end of it—but I knew that space held no muckers, no muggers, no mad stranglers, or crazed drivers, no tenement fires, or fuel storages, or race riots, or blackouts, or gang wars, or reactor meltdowns—

How does Norrey feel about it?

It had taken me a couple of minutes to get this far; as I turned my head to see Norrey's face the acceleration warning sounded. She turned hers too; our noses were scant centimeters apart, and I could see that she had thought it through too. But I couldn't read her reaction.

"I guess I don't mind much going," I said.

"I want to go," she said fervently.

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I blinked. "Phillip Nolan was the man without a country," I said, "and he didn't care for it. *We'll* be the couple without a planet."

"I don't care, Charlie." Second warning sounded.

"You seemed to care back there on the car, when I was bum rapping Earth."

"You don't understand. Those bastards killed my sister. I want to learn their language so I can cuss them out."

It didn't sound like a bad idea.

But thinking about it was. Two gees caught us both with our heads sideways, smacking our cheeks into the couch and wrenching our necks. An eternity later, turnover gave us just enough time to pop them back into place, and then deceleration came for another eternity.

There were "minor" maneuvering accelerations, and then "accleration over" sounded. We unstrapped, both borrowed robes from Bill's locker, and began trading neckrubs. By and by Bill returned. He glanced at the bruises we were raising on opposite sides of our faces and snorted. "Lovebirds. All right, all ashore. Pow-wow time." He produced off duty fatigues in both our sizes, and a brush and comb.

"With who?" I asked, dressing hastily.

"The Secretary General of the United Nations," he said simply.

"Jesus Christ."

"If he was available," Bill agreed.

"How about Tom?" Norrey asked. "Is he all right?"

"I spoke with Panzarella," Bill answered. "McGillicuddy is all right. He'll look like strawberry yogurt for a while, but no significant damage—"

"Thank God."

"—Panzarella's bringing him here with the others, ETA—" he checked his chronometer pointedly, "five hours away."

"*All* of us?" I exclaimed. "How big is the bloody ship?" I slipped on the shoes.

"All I know is my orders," Bill said, turning to go. "I'm to see that the six of you are delivered to Skyfac, soonest. And, I trust you'll remember, to keep my damn mouth shut." *Why Skyfac*? I wondered again.

"Suppose the others don't volunteer?" Norrey asked.

Bill turned back, honestly dumbfounded. "Eh?"

"Well, they don't have the personal motivations Charlie and I have."

"They have their duty."

"But they're *civilians*."

He was still confused. "Aren't they humans?"

She gave up. "Lead us to the secretary general."

None of us realized at the time that it was a good question.

Tokugawa was in Tokyo. It was just as well; there was no room for him in his office. Seven civilians, six military officers. Three of the latter were Space Command, the other three national military; all thirteen were of

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high rank. It would have been obvious had they been naked. All of them were quiet, reserved; none of them spoke an unneccesary word. But there was enough authority in that room to cut with a knife.

And it was agitated authority, nervous authority, faced not with an issue but a genuine crisis, all too aware that it was making history. Those who didn't look truculent looked extremely grave. A jester facing an audience of lords in this mood would have taken poison.

And then I saw that all of the military men and one of the civilians were trying heroically to watch everyone in the room at once without being conspicuous, and I put my fists on my hips and laughed.

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The man in Carrington's excuse me, in Tokugawa's chair looked genuinely startled. Not offended, not even annoyed—just surprised.

There's no point in describing the appearance or recounting the accomplishments of Siegbert Wertheimer. As of this writing he is still the Secretary General of the United Nations, and his media photos, like his record, speak for themselves. I will add only that he was (inevitably) shorter than I had expected, and heavier. And one other, entirely subjective and apolitical impression: in those first seconds of appraisal I decided that his famous massive dignity, so beloved by political cartoonists, was intrinsic rather than acquired. It was the cause of his impressive track record, I was certain, and not the result of it. He did not seem like a humorless man—he was simply astounded that someone had *found* some in this mess. He looked unutterably weary.

"Why is it that you laugh, sir?" he asked mildly, with that faintest trace of accent.

I shook my head, still grinning uncontrollably. "I'm not sure I can make you see it, Your Excellency." Something about the set of his mouth made me decide to try. "From my point of view, I've just walked into a very implausible B-movie."

He considered it, momentarily imagining what it must be like to be an ordinary human thrust into the company of agitated lions, and grinned himself. "Then at least we shall try to make the dialogue fresh," he said. A good deal of his weariness seemed to be low gee malaise, the discomfort of fluids rising to the upper body, the feeling of fullness in the head and the vertigo. But only his body noticed it. "Let us proceed. I am impressed by your record, Mr.—" He glanced down, and the paper he needed was not there. The American civilian had it, and the Russian general was looking over his shoulder. Before I could prompt him, he closed his eyes, jogged his memory and continued, "—Armstead. I own three copies of the *Stardance*, and the first two are played out. I have recently viewed your own recordings, and interviewed several of your former students. I have a job that needs doing, and I think you and your troupe are precisely the people for that job."

I didn't want to get Bill in trouble, so I hung a dumb look on my face and waited.

"The alien creatures you encoun-

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tered with Shara Drummond have been seen again. They appear to be in a parking orbit around the planet Saturn. They have been there for approximately three weeks. They show no sign of any intention to move, nearer to or farther from us. Radio signals have been sent, but they elicited no response. Will you kindly tell me when I come to information that is new to you?"

I knew I was caught, but I kept trying. In low gee, you *chase* spilled milk—and often catch it. "*New* to me? Christ, all of it's—"

He smiled again. "Mr. Armstead, there is a saying in the U.N. We say, 'there are no secrets in space.' "

It is true that between all humans who choose to live in space, there is a unique and stronger bond than between any of them and anyone who spends all his life on Earth. For all its immensity, space has always had a better grapevine than a small town. But I hadn't expected the Secretary General to know that.

Norrey spoke while I was still reevaluating. "We know that we're going to Saturn, Your Excellency. We don't know how, or what will happen when we get there."

"Or for that matter," I added, "why this conference is taking place in Skyfac cubic."

"But we understand the personal implications of a space trip that long, as you must have known we would, and we know that we have to go."

"As I hoped you would," he finished, respectfully. "I will not sully your bravery with words. Shall I answer your questions, then?"

"One moment," I interjected. "I understand that you want our entire troupe. Won't Norrey and I do? We're the best dancers—why multiply your payload?"

"Payload mass is not a major consideration," Wertheimer said. "Your colleagues will be given their free choice—but if I can have them, I want them."

"Why?"

"There will be four diplomats. I want four interpreters. Mr. Stein's experience and proven expertise are invaluable—he is, from his record, unique. Mr. Brindle can help us learn the aliens' response to visual cues designed by computers which have seen the *Stardance* tapes—the same sort of augmentation he provides for you now. A sort of expanded vocabulary. He will also provide a peaceful excuse for us to judge the aliens' reaction to laser beams."

His answer raised several strong objections in my mind, but I decided to reserve them for later. "Go on."

"As to your other questions. We are guests of Skyfac Incorporated because of a series of coincidences that almost impels me to mysticism. A certain unusual transfer is required in order to get a mission to Saturn at all expediently. This transfer, called Friesen's Transfer, must be begun from a 2:1 resonance orbit. Skyfac has such an orbit. It is a convenient outfitting base unequaled in space. And by chance, *Siegfried*, the Saturn probe which the

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world scientific community was planning to launch this month is in a precessing ellipse orbit which brought it within the close vicinity of Skyfac at the right time. An incredible coincidence, on a par with the coincidence that the launch window for Saturn opened concurrent with the aliens' appearance there.

"I do not believe in good fortune of that magnitude. I suspect personally that this is some kind of intelligence and aptitude test—but I have no evidence beyond what I have told you. My speculations are as worthless as anyone's. We must have more information."

"How long does that launch window remain open?" I asked.

Wertheimer's watch was as Swiss as he, exquisite and expensive, but so old-fashioned that he had to look at it. "Perhaps twenty hours."

Oof. Now for the painful one. "How long is the round trip?"

"Assuming zero time in negotiation, three years. Approximately one year out and two back."

I was pleasurably startled at first: three years instead of twelve to be cooped up in a canful of diplomats. But then I began to grasp the accelerations implied in an untested ship built by a government on low-bid contracts. And it was still more than enough time for us all to adapt permanently to zero gee. Still, they obviously had something special and extraordinary up their sleeves.

I grinned again. "Are you going?"

A lesser man would have said, "I regret that I cannot," or something equally self-absolutory—and would have been completely honest at that. Secretary Generals don't go chasing off to Saturn, even if they want to.

But all he said was "No," and I was ashamed that I had asked the question.

"As to the question of compensation," he went on quietly, "there is of course none adequate to the sacrifice you are making. Nevertheless, should you, upon your return, elect to continue performing, all your operating costs will be covered in perpetuity by the United Nations. Should you be disinclined to continue your careers, you will be guaranteed unlimited lifetime transport to and from, and luxury accommodations at, any place within United Nations jurisdiction."

I gaped. We were being given a paid up lifetime plane ticket to anywhere in human space. If we survived to collect it.

"This is in no sense to be considered payment; any attempt at payment would be laughable and grotesque. But you have chosen to serve; your species is grateful. Is this satisfactory to you?"

I thought about it, turned to Norrey. We exchanged a few paragraphs by facial telegraph. "We accept the blank check," she said. "We don't promise to cash it."

He nodded. "Perhaps the only sensible answer. All right, let us—"

"Sir," I said urgently, "I have something I have to say first."

"Yes?" He did me the honor of

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displaying patience.

"Norrey and I are willing to go, for our own reasons. I can't speak for the others. But I *must* tell you that I have no great confidence that *any* of us can do this job for you. I will try my best—but frankly I expect to fail."

The Chinese general's eyes locked onto me. "Why?" he snapped.

I continued to look at Wertheimer. "You assume that because we are Stardancers, we can interpret for you. I cannot guarantee that. I venture to say that I know the *Stardance* tapes, even the classified ones, better than any person here. I shot them. I've monkeyed with speed and image-field until I know every frame by name and I will be damned if I understand their language. Oh, I get flashes, insights, but . . .

"Shara understood them—crudely, tentatively, and with great effort. I'm not half the choreographer she was, nor half the dancer. None of us is. No one I've ever seen is. She told me herself that what communication took place was more telepathy than choreography. I have no idea whether any of us can establish such a telepathic rapport through dance. I wasn't *there*; I was in this oversized donut, four bulkheads away from here, filming the show." I was getting agitated, all the pressure finding release. "I'm sorry, general," I said to the Chinese, "but this is not something you can order done."

Wertheimer was not fazed. "Have you used computers?"

"No," I admitted. "I always meant to when I got time."

"You did not think we would fail to do so? No more than you, do we have an alien/human dictionary—but we know much. You can choreograph by computer?"

"Sure."

"Your ship's computer memories should offer you a year's worth of study on the trip out. They will provide you with at least enough 'vocabulary' to begin the process of acquiring more, and they will provide extensive if hypothetical suggestions for doing so. The research has been done. You and your troupe may be the only humans alive capable of assessing the data and putting them to use. I have seen your performance tapes, and I believe you can do it if anyone can. You are all unique people. You already fit the definition of an alien, at least in your work. You think as well as a human . . . but not *like* a human."

It was the most extraordinary thing anyone had ever said to me; it stunned me more than anything else that was said that day.

"All of you, apparently," he went on. "Perhaps you will meet with failure. In that case you are the best imaginable teachers and guides for the diplomat team, of whom only one has even minimal experience with free fall conditions. They will need people who are at home in space to help them, whatever happens."

He took out a cigarette, and the American civilian turned up the air for him unobtrusively. He lit it with a

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match, himself. It smoked an odd color: it was tobacco.

"I am confident that all of you will do your best. All of your company who choose to go. I hope that will be all of you. But we cannot wait on the arrival of your friends, Mr. Armstead: there are enormous constraints on us all. If you are to be introduced to the diplomatic mission before take off, it must be now."

Woah oh. Red alert. You're inspecting your housemates for the next two years—just before signing the lease. Pay attention. Harry and the others'll be interested.

I took Norrey's hand; she squeezed mine hard.

And to think I could have been an alcoholic anonymous video man in New Brunswick.

"Go ahead, sir," I said firmly.

"You're shitting me," Raoul exclaimed.

"Honest to God," I assured him.

"It sounds like a Milton Berle joke," he insisted.

"You're too young to remember Milton Berle," Norrey said. She was lying down on the near bunk, nodding off in spite of herself.

"So don't I have a tape library?"

"I agree with you," I said, "but the fact remains. Our diplomatic team consists of a Spaniard, a Russian, a Chinaman, and a Jew."

"My God," Tom said from his reclining position on the other bed, where he had been since he arrived. He did indeed look like strawberry yogurt, lightly stirred, and he complained of intermittent eye and ear pain. But he was shot full of don't-hurt and keep-going, and his hands were full of Linda's; his voice was strong and clear. "It even makes sense."

"Sure," I agreed. "If he's not going to send one delegate from each member nation, Wertheimer's only option is to keep it down to the Big Three. It's the only restriction most everybody can live with. It's *got* to be a multinational team: that business about mankind uniting in the face of the alien menace is bunk."

"Headed by the proverbial man above reproach," Linda pointed out.

"Wertheimer himself would have been perfect," Raoul put in.

"Sure," I agreed dryly, "but he had some pressing obligations elsewhere."

"Ezequiel DeLaTorre will do just fine," Tom said thoughtfully.

I nodded. "Even I've heard of him. Okay, I've told you all we know. Comments? Questions?"

"I want to know about this one year trip time business," Tom spoke up. "As far as I know, that's impossible."

"Me too," I agreed. "We've been in space a long time. I don't know if they can understand how *little* prolonged acceleration we can take at this point. What about it, Harry? Raoul? Can the deed be done?"

"I don't think so," Harry said.

"Why not? Can you explain?"

Guest privileges aboard Skyfac include computer access. Harry jaunted to the terminal, punched up a reference display.

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The screen said:

$$t_2 - t_1 = \sqrt{2p^3/u}\left[\tan\frac{f_2}{2} + \frac{1}{3}\tan^3\frac{f_2}{2} - \tan\frac{f_1}{2} - \frac{1}{3}\tan^3\frac{3f_1}{2}\right]$$

"That's the simplest expression for a transfer time from planet to planet," he said.

"Jesus."

"And it's too simple for your problem."

"Uh—they said something about a freezing transfer."

"Got it," Raoul said. "Friesen's Transfer, on the tip of my mind. Sure, it'd work."

"How?" everyone said at once.

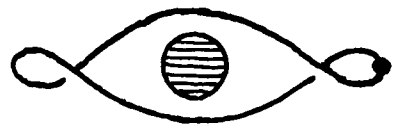
"I used to study all the papers on Space Colonization when I was a kid," Raoul bubbled. "Even when it was obvious that L-5 wasn't going to get off the ground, I never gave up hope—it seemed like the only way I might ever get to space. Lawrence Friesen presented a paper at Princeton once, . . . sure, I remember, '80 or a little earlier. Wait a minute." He hopped rabbitlike to the terminal, used its calculator function.

Harry was working his own belt-buckle calculator. "How're you gonna get a characteristic velocity of two-eight klicks a second?" he asked skeptically.

"Nuclear pulse job?" Tom suggested.

That was what I had been afraid of. I've read that there are people who seriously propose propelling themselves into deep space by goosing themselves with hydrogen bombs—but you'll never get me up in one of them things.

"Hell no," Raoul said—thank goodness. "You don't need that kind of thrust with a Friesen. Watch." He set the terminal for engineering display and began sketching the idea. "You gotta start from an orbit like this:"



"A 2:1 resonance orbit?" I asked.

"That's right," he agreed.

"Like Skyfac?" I asked.

"Yeah, sure, that'd—hey! Hey, yeah—we're just where we want to be. Gee, what a funny coincidence, huh?"

Harry, I could see, was beginning to smell the same rat Wertheimer had. Maybe Tom was, too; all that yogurt got in the way. "So then?" I prompted.

Raoul cleared the screen and calculated some more. "Well, you'd want to make your ship lose, let's see, a little less than a kilometer per second. That's—well, nearly two minutes acceleration at one gravity. Hmmm. Or a tenth-gee, say, about a seventeen minute burn. Nothing.

"That starts us falling toward Earth. What we want to do then is slingshot around it. So we apply an extra . . . 5.44 klicksecs at just the right time. About nine minutes at one gravity, but they won't use one gravity because you need it *fast*. Might be,

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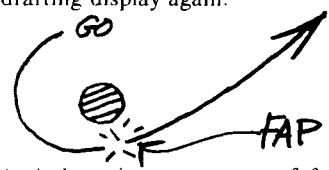
lemme see, 4.6 minutes at two gees, or it might be 2.3 at four."

"Oh fine," I said cheerfully. "Only a couple of minutes at four gees. Our faces'll migrate around to the back of our heads, and we'll be the only animals in the system with frontbones. Go on."

"So you get this," Raoul said, keying drafting display again:



"And that gives us a year of free fall, in which to practice our choreography, throw up, listen to our bones rot, kill the diplomats and eat them, discuss Heinlein's effect on Proust, and bone up on Conversational Alien. Then we're at Saturn. Gee, that's another lucky break, the launch window for a one-year Friesen being open . . ."

"Yeah," Harry interrupted, looking up from his calculator, "that gets you to Saturn in a year—at twelve klicksecs relative. That's more'n escape velocity for Earth."

"We let the ship get captured by Titan," Raoul said triumphantly.

"Oh," Harry said. "Oh. Dump eight or nine klicksecs—"

"Sure," Raoul went on, punching keys. "Easy. A tenth gee for two and a half hours. Or make it easy on ourselves, a hundredth of a gee for a little more than a day. Uh, twenty-five and a half hours. A hundredth gee isn't enough to make pee trickle down your leg, even if you're free fall adapted."

I had actually managed to follow most of the salient points—computer display is a wondrous aid for the ignorant. "Okay then," I said sharply, in my "pay attention, here comes your blocking" voice, focusing everyone's attention by long habit. "Okay. This thing can be done. We've been talking it over ever since two hours before your shuttle docked here. I've told you what they want of us, and why they want all of us. My inclination is to tell you to have your answers ready along about next fall. But the bus is leaving soon. That launch window business you mentioned, Raoul." Harry's eyes flashed suspiciously, and yes, Tom too had picked up on the improbability of such luck. "So," I went on doggedly, "I have to ask for your final answers within the hour. I know that's preposterous, but there's no choice." I sighed. "I advise you to use the hour."

"Damn it, Charlie," Tom said with real anger, "is this a family or isn't it?"

"I—"

"What kind of shit is that?" Raoul agreed. "A man shouldn't insult his friends."

Linda and Harry also looked offended.

"Listen, you idiots," I said, giving it my very best shot, "*this is forever.* You'll never ski again, never swim, never walk around under even lunar gravity. You'll never take a shit without technological assistance again."

"Where on Earth can you take a

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shit without technological assistance today?" Linda asked.

"Come on," I barked, "don't give me satire, *think about it*. Do I have to get personal? Harry—Raoul—how many women you figure you're going to date in space? How many would leave behind a whole world to stay with you? Seriously, now. Linda—Tom—do you know of any evidence at all to suggest that childbirth is *possible* in free fall? Do you want to bet two lives someday? Or had you planned to opt for sterilization? Now the four of you stop talking like comic book heroes and *listen to me*, goddammit." I discovered to my transient surprise that I genuinely was blazing mad. A little histrionics is a dangerous thing. "We have no way of knowing whether we can communicate with the goddam fireflies. On a gamble with odds that long, stakes this high, two lives is enough to risk. *We don't need you guys anyway*," I shouted, and then I caught myself.

"No," I went on finally, "that's a lie. I won't try to claim that. But we can *do* it without you if it can be done at all. Norrey and I have personal reasons for going—but what do *you* want to throw away a planet for?"

There was a glutinous silence. I had done my best; Norrey had nothing to add. I watched four blank, expressionless faces and waited.

At last Linda stirred. "We'll solve zero gee childbirth," she said with serene confidence, and added, "When we have to," a second later.

Tom had forgotten his discomforts. He looked long at Linda, smiling with puffy lips amid his burst capillaries, and said to her, "I was raised in New York. I've known cities all my life. I never realized how much tension was involved in city life until I stayed at your family's home for a week. And I never realized how much I hated that tension until I noticed how much I was getting to dread having to go dirtside again. You only realize how stiff your neck and shoulders were when someone rubs them out for you." He touched her cheek with blood-purple fingernails. "It will be a long time before we have to put a lock on our airlock. Sure, we'll have a child someday—and we won't have to teach it how to adapt to a jungle."

She smiled, and took his purple fingers in her own. "We won't have to teach it how to walk."

"In zero gee," Raoul said meditatively, "I'm taller." I thought he meant the few centimeters that every spine stretches in free fall, but then he said, "In zero gee, *nobody* is short."

By golly, he was right. "Eye-level" is a meaningless term in space; consequently so is height.

But his voice was speculative; he had not committed himself yet.

Harry sucked beer from a bulb, belched, and studied the ceiling. "On my mind. For a long time. This adapting stuff. I could work all year insteada half. See a job through for once. Was thinking of doing it anyway." He looked at Raoul. "Don't figure I'll miss the ladies any."

Raoul met his eyes squarely. "Me

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either," he said, and this time his voice held commitment.

Light dawned in the cerebral caverns, and my jaw hung down. "Jesus Christ in a p-suit!"

"It's just a blind spot, Charlie," Linda said compassionately.

She was right. It has nothing to do with wisdom or maturity or how observant I am. It's just a personal quirk, a blind spot. I never will learn to notice love when it's under my nose.

"Norrey," I said accusingly, "you know I'm an idiot, why didn't you *tell* me, Norrey?"

She was sound asleep.

And all four of them were laughing like hell at me, and after a second I had to laugh too. Any man who does not know himself a fool is a damned fool. Any man who tries to hide it is a double damned fool, for he is alone. Together, we laughed, diminishing my foolishness to a shared thing, and Norrey half smiled in her sleep.

"All right," I said when I could get my breath, "someone for all and all for someone. I won't try to fight the weather. I love you all, and will be glad of your company. Tom, you stretch out and get some sleep yourself. Raoul, get the light; the four of us'll go get briefed and come back for you and Norrey, Tom; we'll pack your comic books and your other tunic. You still mass around seventy-two, right?" I bent and kissed Norrey's forehead. "Let's *roll* it."

CHAPTER SIX

It was a week after that day that we next found an opportunity to all talk together—and we spent the first hour and a half of our opportunity in relative silence. A week locked in a steel can with many strangers had turned out to be even less fun than a comparable period with as many students. Most of these strangers were our employers, the other two were our Space Command keepers, none of them were our subordinates and nearly all of them were temperamentally unsuited to live with artists. All things considered, we handled the close quarters and tension much better than we had in the early days of the Studio—which surprised me.

But as soon as we could, we all went out for a stroll together. And discovered that we had *much* more important things to do than compare notes, at first.

Distance shrank the mighty *Siegfried,* but refused to turn it into a Space Commando model; it retained its massive dignity even when viewed from truly Olympian perspective. I felt an uncharacteristic rush of pride at belonging to the species that had built it and hurled it at the sky. It lightened my mood like a shot of oxygen. I tugged at the three kilometers of line that connected me to the great ship, enjoyed the vast snakelike ripples I caused, let their influence put me in a slow roll, like an infinite swan dive.

Space turned around me.

Tom and Linda came into view. I didn't call out to them—their breath-

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ing told me that they were in deep meditative trance, and my eyes told me how they had got there. You take that oldest and most enduring of children's toys, the slinky. You weld thin flat plates on either end, and bring the accordionlike result out into free space. You place the plates together, so that the slinky describes a circle. Then you let go. Watch the result for long enough, and you too will go into deep trance. The Worm Ourobouros endlessly copulating with himself. They would hear me if I called them by name; they would hear nothing else.

Raoul came into frame next, seen side-on to me. With deadly, matter-of-fact accuracy, he and Harry were hurling that other most durable of toys—a frisbee (neon rimmed for visibility)—back and forth across a couple of kilometers of emptiness. This too was more a meditational exercise than anything else; there is next to no skill involved. A flying saucer, it turns out, really *is* the most dynamically stable shape for a spacecraft. (Take a missile shaped like the old science fiction spaceships, fins and all, and throw it any way you want, with "Kentucky rifle" spin or without: sooner or later it will tumble. A sphere is okay—but unless it was formed in free fall, it's imperfect: it'll wobble, worse and worse as it goes.) They were practiced partners: their thruster use was minimal.

Norrey was skipping rope with a bight of her lifeline. Naturally she was rotating in the opposite direction. It was incredibly beautiful to watch, and I canceled my rotation to enjoy it. Perhaps, I thought lazily, we could work that into a dance someday. Dynamic balance, yin and yang, as simple and as complex as a hydrogen atom.

"Don't atoms dance, Charlie?"

I stiffened, then grinned at myself and relaxed. *You can't haunt me, Shara,* I told the hallucinatory voice. *You and I are at peace. Without me you could never have done the thing you did; without you I might never have been whole again. Rest in peace.*

I watched Norrey some more, in a curiously detached state of mind. Considered objectively, my wife was nowhere near as stunningly beautiful as her dead sister had been. Just strikingly beautiful. And never once in the decades of our bizarre relationship had I ever felt for Norrey the kind of helpless consuming passion I had felt for Shara every minute of the few years I knew her. Thank God. I remembered that passion, that mindless worship that sees a scuff on an apartment floor and says *there she placed her foot*, that sees a battered camera and says *with that I taped her*. The sleepless nights and the rivers of Scotch and the insulted hookers and the terrible awakenings; through it all the continuous yearning that nothing will abate and only the presence of the loved one will assuage. My passion for Shara had died, vanished forever, almost at the same moment that she did. Norrey had been right, two years ago in Le Maintenant: you only conceive a pas-

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sion like that for someone you think you can't have. And the very worst thing that can happen to you is to be wrong.

Shara had been very kind to me.

The love I now shared with Norrey was much quieter, much gentler on the nervous system. Why, I'd managed to overlook it for years. But it was a richer kind of love in the end.

"Has it occurred to any of you," I asked lazily, "that living in space has just about matured us to the point of early childhood?"

Norrey giggled and stopped skipping. "What do you mean, love?"

Raoul laughed. "It's obvious. Look at us. A slinky, a frisbee, and a jump rope. The thrusting apex of modern culture, kids in the biggest playground God ever made."

"On tethers," Norrey said, "like country kids, to keep us out of the garden."

"Feels good to me," Harry put in.

Linda was coming out of meditation, her voice was slow, soft. "Charlie is right. We have matured enough to become childlike."

"That's closer to what I meant," I said approvingly. "Play is play, whether it's a tennis racquet or a rattle. I'm not talking about the kinds of toys we choose, so much. It's more like . . ." I paused to think, and they waited. "Listen, it seems to me that I have felt like an old old man since I was about, what, nine years old. These past few years have been the adolescence I never had, and now I'm happy as a child again."

Linda began to sing:

"*Can't remember when I've ever been so happy*

Happier than I can say

I used to feel older than my own grandpappy

But I'm getting younger every day

"It's an old Nova Scotia song," she finished quietly.

"Teach it to me," Raoul said.

"Later. I want to pursue this thought."

So did I—but just then my alarm watch went off. I fumbled the stud home through the p-suit, and it subsided. "Sorry, gang. Halfway through our air. Let's get together for the group exercises. Form up on Linda and we'll try the Pulsing Snowflake."

"Shit—work again?" "Phooey. We've got a year to get into shape." "Wait'll I catch this sonumbitch, boss," and "Let's get it over with," were the entirely natural sounding responses to the code phrase. We closed ranks and diddled with our radios.

"There we go," I said as I closed. "Right, and Harry, you cross over and take Tom's . . . that's right. Wait, *look out*! Oh Christ!" I screamed.

"No!" Harry shouted.

"Ohmigod," Raoul bubbled. "Ohmigod his suit's ripped *his suit's ripped*. Somebody *do* something, ohmigod—"

"Mayday," I roared. "*Siegfried* from Stardancers, Mayday, goddamn it. We've got a blown suit, I don't think I can fix it, *answer me*, will you?"

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Silence, except for Harry's horrible gurgling.

"*Siegfried*, for the love of God, come *in*. One of your precious interpreters is dying out here!"

Silence.

Raoul swore and raged, Linda said calming things to him, Norrey prayed softly.

Silence.

"I guess that damper circuit works, Harry," I said approvingly at last. "We've got privacy. By the way, that gurgling was horrible."

"When did I have a chance to rehearse? And we got a whole hour and a half's worth of privacy."

"Yeah, they won't buy an exercise session longer than that. You got that heavy breathing tape going?"

"In circuit," Harry agreed. "Heavy breathing and cadence counts, no repeats."

"So if anyone's listening, they're just, uh, getting into our pants," Raoul said almost inevitably.

"*O*-kay," I said, "let's talk family talk. We've each spent some time with our assigned partners. What's the consensus?"

Some more silence.

"Well, has anybody got presentiments of doom? Choice gossip? Tom? You follow politics, you knew most of these people by reputation anyway. Tell us all about that first, and then we can compare personal impressions."

"All right, let's see—is there anything to be said about DeLaTorre? If he is not a man of honor and compassion, no one is. Even his critics admire him, and a good half of them are willing to admit it. I'll be honest: I'm not as certain of *Wertheimer*'s integrity as I am of DeLaTorre's. Except of course that he *picked* DeLaTorre to head this posse, which raises him a notch. Anybody feel different? Charlie, he's your puppetmaster, what do you say?"

"A heartfelt ditto. I'd turn my back on him in the airlock. Go on."

"Ludmilla Dmirov has a similar reputation for moral toughness, unpusharoundable. She was the first diplomatic official ever to turn down a state owned *dacha* in Sovmin. Those of you who don't know *nomenklatura*, the patronage system in Moscow, a *dacha* is sort of a country cabin for high ranking officials, and turning one down is like a freshman senator refusing to vacation or junket, or a rookie cop turning down the usuals. Unthinkable . . . and dangerous." He paused. "But I can't be as certain that it's integrity with her. It may just be orneriness. And compassionate she is *not*."

Norrey was assigned to Dmirov; she spoke up. "I'm not sure I agree, Tom. Oh, she plays chess like a machine, and she sure knows how to be impenetrable—and maybe she *doesn't* know enough about when and how to turn it off. But she showed me all her son's baby pictures, and she told me that the *Stardance* made her cry. 'Weep from the chest,' she said. I think the compassion's in there."

"Okay," Tom said. "I'll take your word. And she *was* one of the ones who pushed hard for a U.N. Space

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Command. Without her there just might not *be* a U.N. any more, and space might have become the next Alsace-Lorraine. I'm willing to believe her heart's in the right place." He paused again. "Uh, with all due respect, I don't think I'd be prepared to turn my back on her in the airlock yet. But my mind's open.

"Now, Chen," he went on, "was also a prime mover in the formation of the Space Command—but I'll lay odds that it was a chess-player's move for him. I think he took a cold extrapolative look at the future and decided that if the world *did* blow itself up over the issue of space, it would seriously restrict his political career. He is reputed to be one sharp horse trader and one cold son of a bitch, and they say the road to hell is paved with the skins of his enemies. He owns a piece of Skytac Inc. I wouldn't turn my back on him on live network TV, and Linda, I hope you won't either."

"That is certainly the image he has cultivated," she agreed. "But I must add a few things. He is impeccably polite. He is a philosopher of incredible perception and subtlety. And he is rock steady. Hunger, lack of sleep, danger—none of these will affect his performance or his judgment in any measurable way. Yet I find his mind to be open to change and to changes. I believe he might well be a real *statesman*." She broke off, took a deep breath, and finished, "But I don't think I trust him either. Yet."

"Yeah," Tom said. "Is he a statesman for mankind or for the People's Republic? Okay, that leaves my own man. Whatever else you can say about the others, they're probably all statespersons. Sheldon Silverman is a politician. He's held just about every elective office except president and vice president. He could have been the latter any time he was silly enough to want to; only some incredibly subtle errors cost him the former. I think he bought or bribed his way onto this trip somehow, as his last chance to earn a whole page in the history books. I think he sees *himself* as the leader of the team, by virtue of being an American. I despise him. He costs Wertheimer the notch that DeLaTorre earned him, as far as I'm concerned." He shut up suddenly.

"I think you may be holding his past against him," Linda said.

"Damn right," he agreed.

"Well—he's old. Some old people change, quite radically. Zero gee has been working on him: wait and see. We should bring him out here some time."

"My love, your fairness is showing."

"Damn right," she said, forcing a grin from him. "It sort of has to."

"Huh?"

"He gives me the *creeps*."

"Oh. I see. I think."

"Harry, Raoul," I said, "you've been hanging out with the Space Commandos."

Raoul took it, of course. "Cox we all know or know about. I'd let him hold the last air bottle while I took a leak. His second in command is an old time

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NASA science officer type."

"Jock," Harry put in.

Raoul chuckled. "You know, she is. Susan Pha Song was a Vietnam War baby, raised in 'Nam by her aunt after her father split and her mother got napalmed. Hasn't got much use for America. Physicist. Military through and through; if they told her to she'd nuke Vietnam and drop rose petals on Washington. She disapproves of music and dance. And me and Harry."

"She'll follow orders," Harry asserted.

"Yeah. For sure. She's a chicken colonel as of last week, and in the event Commander Cox drops dead, the chain of command goes her, then Dmirov, presumably. She's got pilot training, she's a space freak."

"If it comes to that extreme," I said, "I for one am going free-lance."

"Chen Ten Li has a gun," Linda said suddenly.

"*What*?"[5]

"What kind?" from Harry.

"Oh, I don't know. A small handgun, squarish looking. Not much barrel."

"How did you get a look at it?" I asked.

"Jack-in-the-box effect. Took him by surprise, and he recovered late."

The jack-in-the-box effect is one of the classic surprises of free fall, predictable but unexpected, and it gets virtually every new fish. Any container, cabinet or drawer you open will spew its contents at you—unless you have thought to velcro them all in place. The practical joke possibilities are nearly inexhaustible. But I smelled a rat. "How about that, Tom?"

"Eh?"

"If Chen Ten Li has been one of the major forces behind intelligent use of space, wouldn't he know about jack-in-the-box?"

Tom's voice was thoughtful. "*Huh*. Not necessarily. Li is one of those paradoxes, like Isaac Asimov refusing to fly. For all his understanding of the issues of space, this is the first time he's been farther off planet than a jetliner goes. He's a groundlubber at heart."

"Still," I objected, "jack-in-the-box is standard tourist anecdote. He'd only need have spoken with one returned spacegoer, for any length of time."

"I don't know about the rest of you," Raoul said, "but there was a lot about zero gee that I knew about intellectually, that I still tripped over when I got there. Besides, what motive could Li have for letting Linda see a gun?"

"That's what bothers me," I admitted. "I can think of two or three reasons offhand—and they all imply either great clumsiness or great cunning. I don't know which I'd prefer. Well . . . anyone else see any heat?"

"I haven't seen a thing," Norrey said judiciously, "but I'd be willing to bet that Ludmilla has a weapon of some kind."

"Anybody else?"

Nobody responded. But each of the diplomats had fetched a sizable mass of uninspected luggage.

"Okay. So the upshot is, we're stuck

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in a subway with three rival gangleaders, two cops, and a nice old man. This is one of the few times I've ever been grateful that the eyes of the world are upon us."

"Much more than the eyes of the world," Linda corrected soberly.

"It'll be okay," Raoul said. "Remember: a diplomat's whole function is to maintain hostilities short of armed conflict. They'll all pull together at the showdown. Most of 'em may be chauvinists—but underneath I think they're all *human* chauvinists, too."

"That's what I mean," Linda said. "Their interests and ours may not coincide."

Startled silence, then, "What do you mean, darling? We're not human?" from Tom.

"Are we?"

I began to understand what she was driving at, and I felt my mind accelerate to meet her thought.

What does it mean to be human? Considering that the overwhelming mass of the evidence has been taken from observation of humans under one gravity, pinned against a planet? By others in the same predicament?

We had surely been born human. Were we still?

"Certainly," Tom said. "Humans are humans whether they float or fall."

"Are you sure?" Linda asked softly. "We are different from our fellows, different in basic ways. I don't mean just that we can never go back and live with them. I mean spiritually, psychologically. Our thought patterns change, the longer we stay in space—our brains are adapting just like our bodies."

I thought of what Wertheimer had said to me the week before—that we choreographed as well as humans but not like humans.

"Our souls, too," she went on. "Each of us spends every working day gazing on the naked face of God, a sight that groundhogs can only simulate with vaulting cathedrals and massive mosques. We have more perspective on reality than a holy man on the peak of the highest mountain on Earth. There are no atheists in space—and *our* gods make the hairy thunderers and bearded paranoids of Earth look silly. Hell, you can't even make out Olympus from the studio—much less from here." The distant Earth and Moon were already smaller than we were used to.

"There's no denying that space is a profoundly moving place," Tom maintained, "but I don't see that it makes us other than human. I *feel* human."

"How did *Cro-Magnon* know he was different from *Neanderthal*?" Raoul asked. "Until he could assess discrepancies, how would he know?"

"The swan thought he was an ugly duckling," Norrey said.

"But his *genes* were swan," Tom insisted.

"*Cro-Magnon*'s genes started out *Neanderthal*," I said. "Have you ever examined yours? Would you know a really subtle mutation if you saw one?"

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"Don't tell me you're buying into this silliness, Charlie?" Tom asked irritably. "Do you feel inhuman?"

I felt detached, listening with interest to the words that came out of my mouth: "I feel other than human. I feel like more than a new man. I'm a new thing. Before I followed Shara into space, my life was a twisted joke, with too many punchlines. Now I am alive. I love and can be loved. I didn't leave Earth behind. I put space ahead."

"Aw, phooey," Tom said. "Half of that's your leg—and I know what the other half is because it happened to me, at Linda's family's place. It's the city mouse in the country effect. You find a new, less stressful environment, get some insights, and start making better, more satisfying decisions. Your life straightens out. So something must be magic about the place. Nuts."

"The mountain *is* magic," Linda said gently. "Why is magic a dirty word for you?" At that stage of their relationship, it suited Tom and Linda to maintain a running pseudodisagreement on matters spiritual. Occasionally they realized what was obvious to the rest of us: that they almost never actually disagreed with each other on anything but semantics.

"Tom," I said insistently, "this is *different*. I've *been* to the country. I'm telling you that I'm not an improved version of the man I was—I'm something altogether different now. I'm the man I could never have been on Earth, had lost all hope of being. I—I believe in things that I haven't believed in since I was a kid. Sure I've had some good breaks, and sure, opening up to Norrey has made my life more than I ever thought it could be. But my whole makeup has changed, and no amount of lucky breaks will do that. Hell, I used to be a drunk."

"Drunks smarten up every day," Tom said.

"Sure—if they can find the strength to maintain cold turkey for the rest of their lives. I take a drink when I feel like it. I just hardly ever feel like it. I stopped *needing* booze, just like that. How common is that? I smoke less these days, and treat it less frivolously when I do."

"So space grew you up in spite of yourself?"

"At first. Later I had to pitch in and work like hell—but it started without my knowledge or consent."

"When did it begin?" Norrey and Linda asked together.

I had to think. "When I began to learn how to see spherically. When I finally learned to cut loose of up and down."

Linda spoke. "A reasonably wise man once said that anything that disorients you is good. Is instructive."

"Look," I said, "we are all unique. I don't suppose the first *Cro-Magnon felt* any different. But the overwhelming evidence suggests that our talent is not a normal human attribute."

"Normal people can live in space," Norrey objected. "Space Command crews. Construction gangs."

"If they've got an artificial local

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vertical," Harry said. "Take 'em outdoors, you gotta give 'em straight lines and right angles or they start going buggy. Most of 'em. S'why we get rich."

"That's true," Tom admitted. "At Skylac a good outside man was worth his mass in copper, even if he was a mediocre worker. Never understood it."

"Because you are one," Linda said.

"One *what*?" he said, exasperated.

"A Space Man," I said, spacing it so the capitals were apparent. "Whatever comes after *Homo habilis* and *Homo sapiens*. You're space-going man. I don't think the Romans had the concept, so '*Homo novis*' is probably the best you can do in Latin. New Man. The next thing."

Tom snorted. "*Homo excastra* is more like it."

"No, Tom," I said gently, "you're wrong. We're *not* outcasts. We may be literally 'outside the camp,' 'outside the fortress'—but the connotation of 'exile' is all wrong. Or are you regretting the choice you made?"

He was a long time answering. "No. No, space is where I want to live, all right. I don't feel exiled—I think of the whole solar system as 'human territory.' But I feel like I've let my citizenship in its largest nation lapse."

"Tom," I said solemnly, "I assure you that that is the diametric opposite of a loss."

"Well, the world does look pretty rotten these days, I'll grant you that. There isn't a *lot* of it I'll miss."

"You miss my point."

"So explain."

"I talked about this with Doc Panzarella some, before we left. What is the normal lifespan for a space man?"

He started to speak twice, stopped trying.

"Right. There's no way to frame a guess—it's a completely new ballgame. *We're the first.* I asked Panzarella, and he told me to come back when two or three of us had died. We may all die within a month, because fatigue products refuse to collect in our feet or our corns migrate to our brains or something. But Panzarella's guess is that free fall is going to add at *least* forty years to our lifespans. I asked him how sure he was and he offered to bet cash."

Everyone started talking at once, which doesn't work on radio. The consensus was, "Say *what*?" The last to shut up and drop out was Tom. "—possibly *know* a thing like that, yet?" he finished, embarrassed.

"Exactly," I said. "We won't *know* 'til it's too late. But it's *reasonable.* Your heart has less work to do, arterial deposits seem to diminish—"

"So it won't be heart trouble that gets us," Tom stipulated, "assuming that lowering the work load that drastically turns out to be good for a heart. But that's one organ out of many."

"Think it through, Tom. Space is a sterile environment. With reasonable care it always will be. Your immune system becomes almost as superfluous as your semicircular canals—and do

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you have any idea how much energy fighting off thousands of wandering infections drains from your life system? That might have been used for maintenance and repair? Or don't you notice your energy level drop when you go dirtside?"

"Well sure," he said, "but that's just . . ."

"—the gravity, you were gonna say? See what I mean? We're healthier, physically and mentally, than we *ever* were on Earth. Oh sure, our bone calcium level goes down, so we take supplements. But who *needs* a skeleton in zero gee? When did you ever have a cold in space? For that matter, when was the last time you got deeply depressed, morose? How come we hardly ever, any of us, have dog days, black depressions and sulks and the like? Hell, the *word* depression is tied to gravity. You *can't* depress something in space, you can only move it. And the very word gravity has come to be a synonym for humorlessness. If there's two things that'll kill you early it's depression and lack of a sense of humor."

In a vivid rush came the memory of what it had felt like to live with a defective leg under one gravity. Depression and lack of a sense of humor. It seemed so long ago, so very far away. Had I ever really been that despairing?

"Anyway," I went on, "Panzarella says that people who spend a lot of time in free fall—and even the people on Luna who stay in one-sixth gee, those exile/miners—show a lower incidence of heart and lung trouble, naturally. But he also says they show a much lower incidence of cancers of all kinds than the statistical norm."

"Even with the higher radiation levels?" Tom asked skeptically.

Whenever there's a solar flare; we all see green polliwogs for a while, as the extra radiation impacts our eyeballs—and it doesn't make any difference whether we're indoors or out.

"Yep," I assured him. "Coming out from under the atmosphere blanket was the main health hazard we all gambled on in living in space—but it seems to've paid off. It *seemed* there should have been a *higher* risk of cancer, but it just doesn't seem to be turning out that way. Go ask why. And the lower lung-trouble rate is obvious—we breathe real air, better filtered than the prime minister's, dust-free, and zero pollen count. Hell, if you had all the money on Earth you couldn't have a healthier environment tailor-made. How about old Mrs. Murphy on Skyfac? What is she, eighty-four?"

"Eighty-five," Raoul said. "And free fall handball champ. She whipped my ass, three games running."

"It's almost as though we were designed to live in space," Linda said wonderingly.

"All right," Tom said, "I give up. I'm sold. We're all going to live to be a hundred and twenty. Assuming the aliens don't decide that we're delicious. But we're a hell of a new species if you ask me. We're parasitic on *Homo sapiens*, unless and until we

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learn how to make our own air, water, food, metals, plastics, tools, cameras.

"Give us time," I said. "We're brand new. Shit, there goes the alarm again. Ten minute warning. Let's get some real dancing done, so we come home sweaty. We'll do this again in a couple of days. Harry, take that heavy breathing tape out of circuit and we'll boost our signal strength together at three, two, one *mark*."

I repeat the previous conversation in its entirety partly because it is one of the few events in this chronicle of which I possess a complete audio recording. But also partly because it contains most of the significant information you need to know about that one year trip to Saturn. There is no point in describing the interior of *Siegfried*, or the day to day schedules or the month by month objectives of the interpersonal frictions that filled up one of the most busy, boring years of my life.

As is common and perhaps inevitable on expeditions of this kind, crew, diplomats, and dancers formed three reasonably tight cliques outside working hours, and maintained an uneasy peace during them. Each group had its own interests and amusements—the diplomats, for instance, spent much of their free time (and a substantial percentage of their working time) fencing politely and otherwise. DeLaTorre's patience soon earned the respect of every person aboard. Read any decent book on life in a submarine, then throw in free fall, and you've got that year. Raoul's music helped keep us all sane, though; he became the only other universally respected passenger.

The six of us somehow never discussed the "new species" line of thought again together, although I know Norrey and I kicked it around hood to hood a few times, and Linda and I spoke of it occasionally. And of course we never mentioned it *at all* anywhere aboard *Siegfried*—spaceships are *supposed* to be thoroughly bugged. The notion that we six dancers were somehow other than human was not one that even DeLaTorre would have cared for—and he was about the only one who treated us as anything but hired hands, "mere interpreters" (Silverman's expression). Dmirov and Li knew better, I believe, but they couldn't help it: as experienced diplomats they were not conditioned to accept interpreters as social equals. Silverman thought dance was that stuff they did on variety shows, and why *couldn't* we translate the concept of Manifest Destiny into a dance?

I will say one thing about that year. The man I had been when I first came to space could not have survived it. He'd have blown out his brains, or drank himself to death.

Instead I went out for lots of walks. And made lots of love with Norrey. With music on, for privacy.

Other than that the only event of note was when Linda announced that

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she was pregnant, about two months out of Saturn. We were committed to solving zero gee childbirth without an obstetrician. Or, for that matter, a G.P.

Things got livelier as we neared Saturn.

CHAPTER SEVEN

We had not succeeded in convincing any of the diplomats to join us in EVA of any kind. Three refused for the predictable reason. EVA is measurably more dangerous than staying safely indoors (as I had been forcibly reminded on the day I had gotten into this), and duty forbade them from taking *any* avoidable risk on their way to what was literally the biggest and most important conference in history. We dancers were considered more expendable, but pressure was put on us to avoid having all four dancers outboard at the same time. I stuck to my guns, maintaining that a group dance must be planned, choreographed and rehearsed *ensemble*—that what Stardancers, Inc. *was*, was a creative collective. Besides, the more buddies you have, the safer you are.

The fourth diplomat, Silverman, had been specifically ordered not to expose himself to space. So early on he asked us to take him out for a walk. Sort of a "they can't tell a fearless SOB like me not to take risks," thing: the order impugned his masculinity. He changed his mind when p-suit plumbing was explained to him, and never brought the subject up again.

But a few weeks before we were to begin deceleration, Linda came to my room and said, "Chen Ten Li wants to come out for a walk with us."

I winced, and did my Silverman imitation. "It would kill you, first to sit me down and say, 'I have bad news for you?' Like that you tell me?"

"Like that he told me."

What would DeLaTorre think? Or Bill? Or the others? Or old Wertheimer, who had told me with his eyes that he believed I could be trusted not to screw up? And as important, why did Chen now want to earn his wings? Not for scenery—he had first class video, the best Terra could provide, which is *good*. Not for jackass reasons like Silverman.

"What does he *want*, Linda? To see a rehearsal live? To drift and meditate? What?"

"Ask him."

I had never seen the inside of Chen's room before. He was playing 3-D chess with the computer. I can barely follow the game, but it was clear that he was losing badly—which

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surprised me immensely.

"Dr. Chen, I understand you want to come outside with us."

He was dressed in tastefully lavish pajamas, which he had expertly taken in for free fall and velcro'd (Dmirov and DeLaTorre had been forced to ask Raoul for help, and Silverman's clothes looked like he had backed into a sewing machine). He inclined his shaven head, and replied gravely, "As soon as possible." His voice was like an old cornet, a little feathery.

"That puts me in a difficult position, sir," I said as gravely. "You are under orders not to endanger yourself. DeLaTorre and all the others know it. And if I did bring you outside, and you had a suit malf, or even a nausea attack, the People's Republic of China

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would ask me some pointed questions. Followed by the Dominion of Canada and the United Nations, not to mention your aged mother."

He smiled politely, with lots of wrinkles. "Is that outcome probable?"

"Do you know Murphy's Law, Dr. Chen? And its corollary?"

His smile widened. "I wish to risk it. You are experienced at introducing neophytes to space."

"I lost two out of seventeen students!"

"How many did you lose in their first three hours, Mr. Armstead? Could I not remain in the Die, wearing a pressure suit for redundancy?"

The Die wasn't cast; it was spot welded. It was essentially a magnesium-framed cube of transparent plastic, outfitted for minimal life support, first aid and self-locomotion through free space. The crew and all the diplomats except Chen called it the Field Support Module. This disgusted Harry, who had designed and built it. The idea was that one of us Stardancers might blow a gasket in midconference, or want to sit out a piece, or conserve air, or for some other reason need a pressurized cubic with a 360° view. It was currently braced tight against the hull of the big shuttlecraft we called the limousine, mounted for use, but it could easily be unshipped. And Chen's pressure suit was regulation Space Command armor, as good or better than even our customized Japanese-made suits. Certainly stronger, better air supply . . .

"Doctor, I have to know *why*."

His smile began to slo-o-owly fade, and when I hadn't blanched or retracted by half past, he let it remain there. About a quarter to frowning. "I concede your right to ask the question. I am not certain I can satisfy you at this time." He reflected, and I waited. "I am not accustomed to using an interpreter. I have facility with languages. But there is at least one language I will never acquire. I was once informed that no one could learn to think in Navajo who was not raised a Navajo. Consequently I went to great lengths to accomplish this, and I failed. I can make myself understood to a Navajo, haltingly. I cannot ever learn to think in that language—it is founded on basically different assumptions about reality that my mind cannot enfold.

"I have studied your dance, the 'language' you will speak for us shortly. I have discussed it with Ms. Parsons at great length, exhausted the ship's computer on the subject. I cannot learn to think in that language.

"I wish to try one more time. I theorize that confrontation with naked space, in person, may assist me." He paused, and grinned again. "Ingesting buds of peyote assisted me somewhat in my efforts with Navajo—as my tutor had promised me. I must expose myself to *your* assumptions about reality. I hope they taste better."

It was by far the most conversation I had gotten out of the epigrammatic Chen since the day we met. I looked at him with new respect, and some aston-

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ishment. And a growing pleasure: here was a friend I had almost missed making. *My God, suppose old Chen is Homo novis!*

"Dr. Chen," I said, when I could get my breath, "let's go see Commander Cox."

Chen listened with total absorption to eighteen hours worth of instruction, most of which he already knew, and asked infrequent but highly insightful questions. I'm willing to bet that before the instruction he could have disassembled any subsystem in his suit in the dark. By the end I'd have bet he could *build* 'em in the dark, starting with free floating components. I have been exposed to a rather high number of extraordinary minds, and he impressed me.

But I *still* wasn't sure I trusted him.

We held the party to three, on the less-to-go-wrong theory—in space, trouble seldom comes in ones. I was the obvious Scoutmaster; I had logged more EVA hours than anyone aboard except Harry. And Linda had been Chen's Alien 101 instructress for the past year; she came along to maintain classroom continuity. And to dance for him, while I played mother hen. And, I think, because she was his friend.

The first hour passed without incident, all three of us in the Die, me at the con. We put a few klicks between us and *Siegfried*, trailing a suspenders-*and*-belt safety line, and came to rest, as always, in the exact center of infinity. Chen was reverentially silent rather than awed, impressed rather than intimidated, absorbed rather than isolated. He was, I believe, capable of encompassing that much wonder—it was almost as though he had always *known* the universe was that big. Still he was speechless for a long time.

So were Linda and I, for that matter. Even at this distance, Saturn looked unbelievably beautiful, beyond the power of words to contain. That planet must unquestionably be the damndest tourist attraction in the solar system, and I had never seen anything so immensely moving in my life.

But we had seen it before in recent days—the whole ship's complement had been glued to the video tanks. We recovered, and Linda told Chen some last thoughts about the way we danced, and then she sealed her hood and went out the airlock to show him some solo work. By prearrangement we were all to remain silent for this period, and Bill too maintained radio silence on our channel. Chen watched with great fascination for three-quarters of Linda's first hour. Then he sighed, glanced at me oddly, and kicked himself across the Die to the control panel.

I started to cry out—but what he reached for was only the Die's radio. He switched it off. Then he removed his helmet in one seemingly practiced move, disconnecting his suit's radio. I had my own hood off to save air, and grabbed for it when I saw him kill the radio, but he held a finger to his lips

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and said, "I would speak with you under the rose." His voice was thin and faint in the low pressure.

I considered the matter. Assuming the wildest paranoid fantasy, Linda was mobile and could see anything that happened in the transparent cube. "Sure," I called.

"I sense your unease and understand and respect it. I am going to put my hand in my right pouch and remove an object. It is harmless." He did so, producing one of those microcorders that looks like a fancy button. "I wish there to be truth between us," he added.

I groped for an appropriate response. Was it low pressure stridency alone that gave his voice that edge? Beyond him, Linda was whirling gracefully through space, sublimely pregnant, oblivious. "Sure," I said again.

He thumbnailed the playback niche. Linda's voice said something that I couldn't hear, and I shook my head. He rewound to the same cue and underhanded it gently toward me.

"That's what I mean," Linda's voice repeated. "Their interests and ours may not coincide."

The tape record I spoke of a while ago.

My brain instantly went on computer time, became a hyperefficient thinking machine, ran a thousand consecutive analysis programs in a matter of microseconds, and self-destructed. *Hand in the cookie jar. Halfway down the mountain and the brakes are gone. I'd have sworn I closed that airlock.* The microcorder hit me in the cheek; instinctively I caught it on the rebound and shut it off as Tom was asking Linda, "Aren't we human?"

And *that* echoed in the Die for a while.

"Only an imbecile would find it difficult to bug an unguarded pressure suit," Chen said tonelessly.

"Yeah," I croaked, and cleared my throat. "Yeah, that was stupid. Who else—?" I broke off and slapped my forehead. "*No.* I don't want to ask any stupid questions. Well, what do *you* think, Chen Ten Li? *Are* we *Homo novis*? Or just gifted acrobats? I'm goddamned if I know."

He jaunted cleanly back to me, like an arrow in slow motion flight. Cats jaunt like that. "*Homo caelestis*, perhaps," he said calmly, and his landing was clean. "Or possibly *Homo ala anima*."

"Allah who? Oh—'winged soul.' Huh. Okay. I'll buy that. Let me try a whammy on *you*, Doc. I'll bet a cookie that you're a 'winged soul' yourself. Potentially, at least."

His reaction astonished me. I had expected a sudden poker face. Instead naked grief splashed his face, stark loss and hopeless yearning, etched by Saturnlight. I never saw such wide open emotion on his face before or since; it may be that no one but his aged mother and his dead wife ever had. It shocked me to my socks, and it would have shocked him too if he had been remotely aware of it.

"No, Mist' Armstead," he said bleakly, staring at Saturn over my

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shoulder. His accent slipped for the first and last time, and absurdly reminded me of Fat Humphrey. "No, I am not one of you. Nor can time or my will make it so. I *know* this. I am reconciled to this." As he got this far, his face began relaxing into its customary impassivity, all unconsciously. I marveled at the discipline of his subconscious mind, and interrupted him.

"I don't know that you're right. It seems to me that any man who can play 3-D chess is a prime candidate for *Homo whateverthehell*."

"Because you are ignorant of 3-D chess," he said, "and of your own nature. Men play 3-D chess on Earth. It was designed under one gravity, for a vertical player, and its classic patterns are linear. I have tried to play in free fall, with a set that is not fixed in that relationship to me, and I cannot. I can consistently beat the Martin-Daniels Program at flat chess." (World class.) "But in free fall 3-D Mr. Brindle could easily defeat me, if I were unvain enough to play him. I can coordinate myself well enough aboard *Siegfried* or in this most linear of vehicles. But I can never learn to live for any length of time without what you call a 'local vertical.'"

"It comes on slow," I began.

"Five months ago," Chen interrupted, "the night light failed in my room. I woke instantly. It took me twenty minutes to locate the light switches. During that entire time I wept with fear and misery, and lost control of my sphincters. The memory offended me, so I spent several weeks devising tests and exercises. I must have a local vertical to live. I am a normal human."

I was silent a long time. Linda had noticed our conversation; I signaled her to keep on dancing and she nodded. After I had thought things through I said, "Do you believe that our interests will fail to coincide with yours?"

He smiled, all diplomat again, and chuckled. "Are you familiar with Murphy's Law, Mr. Armstead?"

I grinned back. "Yeah, but is it *probable*?"

"I don't believe so," he answered seriously. "But I believe that Dmirov would believe so. Possibly Ezequiel. Possibly Commander Cox. Certainly Silverman."

"And we must assume that any of them might also have bugged a suit."

"Tell me: do you agree that if this conference generates any information of great strategic value, Silverman will attempt to establish sole possession of it?"

Chatting with Chen was like juggling chainsaws. I sighed. We were being honest. "Yeah—if he got a chance to pull it off, sure. But that'd take some doing."

"One person with the right program tapes could bring *Siegfried* close enough to Terra for retrieval," he said, and I noticed that he didn't say "one man."

"Why are you telling me this?"

"I am presently jamming any possible bugs in this vehicle. I believe

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Silverman will attempt this thing. I smell it. If he does, I will kill him at once. You and your people react quickly in free fall; I want you to understand my motives."

"And they are?"

"Preservation of civilization on Terra. The continued existence of the human race."

I decided to try throwing *him* a hot one. "Will you shoot him with that automatic?"

He registered faint distaste. "I cycled that out the airlock two weeks after departure," he said. "An absurd weapon in free fall, as I should have realized. No, I shall probably break his back."

Don't give this guy strong serves: his return is murder.

"Where will you stand in that event, Mr. Armstead?"

"Eh?"

"Silverman is a fellow Caucasian, a fellow North American. You share a cultural matrix. Is that a stronger bond than your bond with *Homo caelestis*?"

"Eh?" I said again.

"Your new species will not survive long if the green Earth is blown apart," Chen said harshly, "which is what that madman Silverman would have. I don't know *how* your mind works, Mr. Armstead: *what will you do*?"

"I respect your right to ask the question," I said slowly. "I will do what seems right to me at the time. I have no other answer."

He searched my face and nodded. "I would like to go outside now."

"Jesus Christ," I exploded, and he cut me off.

"Yes, I know—I just said I couldn't function in free space, and now I want to try." He gestured with his helmet. "Mr. Armstead, I anticipate that I may die soon. Once before that time I must hang alone in eternity, subject to no acceleration, without right angles for frames, in free space. I have dreamed of space for most of my life, and feared to enter it. Now I *must*. As nearly as I can say it in your language, I must confront my God."

I wanted to say yes. "Do you know how much that can resemble sensory deprivation?" I argued. "How'd you like to lose your ego in a space suit? Or even just your lunch?"

"I have lost my ego before. Someday I will forever. I do not get nauseous." He began putting his helmet on.

"No, dammit, watch out for the nipple. Here, let me do it."

After five minutes he switched his radio back on and said, shakily, "I'm coming in now." After that he didn't say anything until we were unbuttoning in *Siegfried*'s shuttlecraft bay. Then he said, very softly, "It is I who am *Homo excastra*. And the others," and those were the last words he said to me until the first day of Second Contact.

What I replied was, "You are always welcome in my home, Doctor," but he made no reply. ■

TO BE CONTINUED

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BEN BOVA

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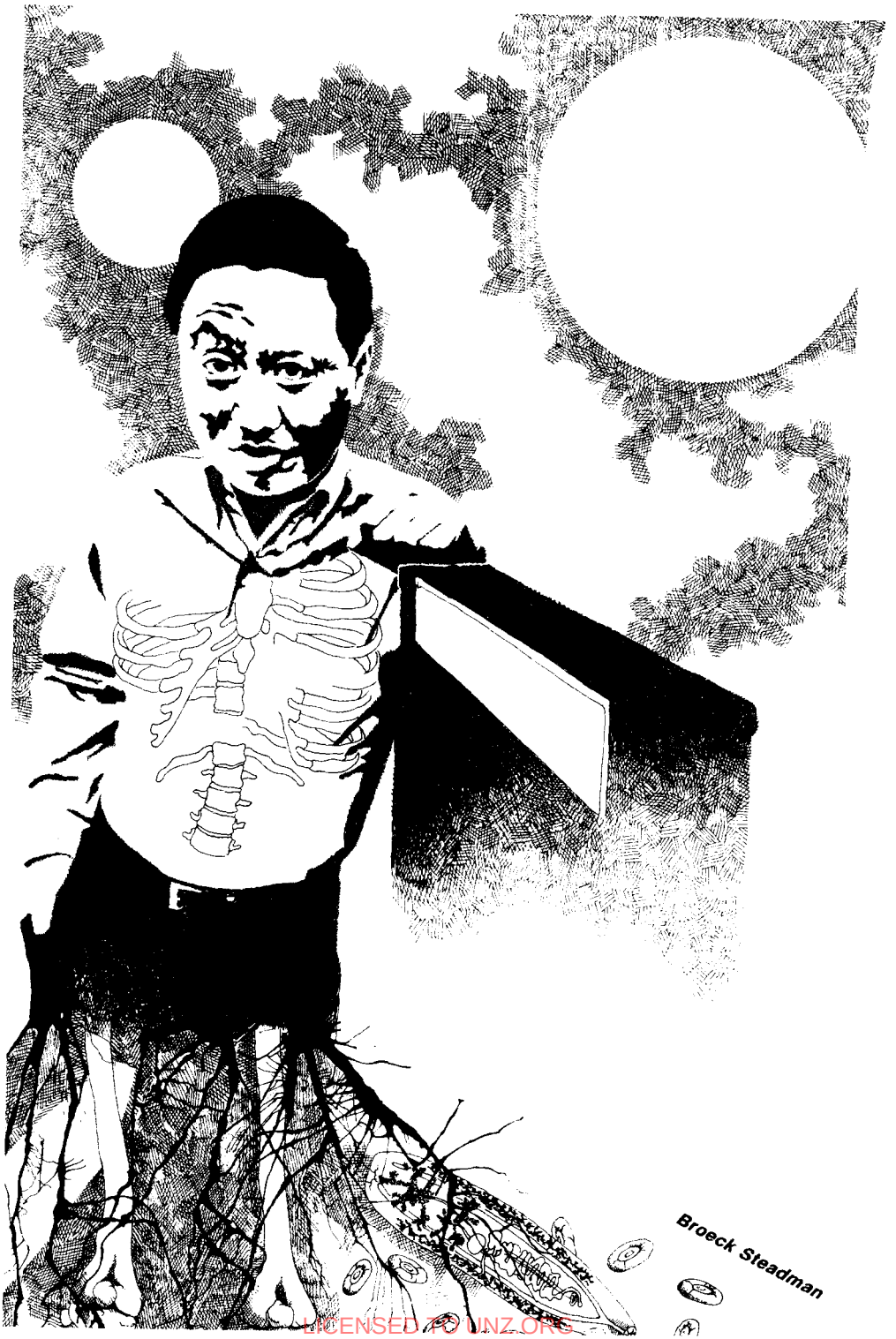

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varieties of technological experience

The Mother of Invention makes the punishment fit the crime.

BARRY MALZBERG

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So for his various crimes against the Federation, none of which had to be explained to him (since he knew his guilt; since his entire life, he thought, was a stain of implication) they exiled Fritz to the fourth division of the Doom World which in real life was the climate-controlled sixth satellite of Neptune and there for his various crimes against the Federation explained that in order to buy his release Fritz would have to invent a universal solvent. In return for a sample they would grant him full remission and allow him to return to his old life although of course under Federation surveillance. Fair was fair.

Fritz explained to them that the basic problem with a universal solvent was that it would dissolve any container and therefore could not be segregated. They responded that this was his problem. He asked if a formula would be sufficient with the various technicians of the Doom Planet actually preparing a batch for use. They said that this was impossible, that they already had many formulas. What they needed was proof of utility. They were very kind. Everyone on the Doom Planet was reasonable. They were not there to be punitive; it was assumed that banishment was sufficiently traumatic. What they were seeking, they explained in the most pleasant way, were results. They offered him full laboratory facilities and assistants if he desired.

Fritz, embittered, discussed the situation with his three roommates in the Dark Quarter, all of whom had been confined much longer than he. He found that he was unable to elicit much sympathy. One of them had been working on a perpetual motion device for some years, another had failed with antigravitation despite some new observations into metallurgics, and the third who thought he had had a workable disintegrator some years ago had blown out half of his laboratory facilities but in demonstration before the administrator had been unable to produce any results other than a slightly charred hand which he claimed still gave him trouble in delicate work. "What you have to understand," the perpetual motion man said, "is that we have been handed ancient scientific paradoxes, impossibilities by definition. We have been given a life sentence in other words but on the other hand if we were able to defy physical laws it would be to the advantage of the Federation and they would certainly release us in gratitude. They have no shortage of potential prisoners, you know."

Fritz had become very cynical about the Federation since his detention and exile—he was beginning to suspect that it was an autocratic government interested only in self-perpetuation and any popular resistance would be defined as a "crime"—but the influence of his early technological training still sat heavy upon him and he found himself unable to accept what the perpetual motion man was saying. "They would never assign an impossible task," Fritz said. "Ultimately the Federation is a rational agency,

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founded upon rational principles. If there were not a way, they would not have assigned this to us. Actually it is a test."

"It is a test, all right," the antigravity man said, "a test of our gullibility."

"A universal solvent would eat out its container," the disintegrator man said. "It could not be conveyed."

"I pointed this out to them."

"He pointed it out to them," the perpetual motion man said and poked antigravity in the ribs. "And they of course agreed and assigned you something else."

"Oh no," Fritz said. "They said that it was my problem."

"That it is," the perpetual motion man said. "And that is what they told *me*. I have incidentally been here for more than half my lifetime and until you joined us here I was the newcomer of this group. Of course there are those like you coming in all the time so I have accumulated a fair amount of seniority, haven't I lads?"

The call to serving quarters interrupted the harsh laughter of the others and Fritz found that he had no desire to continue the discussion later. It was true what he had heard of the Doom Planet, despite the fact that the felons lived together and were exposed, almost mercilessly, to one another's personalities they tended to lead very solitary lives without much connection. Part of that came from the consuming and obsessive nature of the tasks they were assigned of course and another part came from the personality-set of a person foolish enough to try to overthrow the Federation. Stubborn, self-willed, monomaniacal types. Fritz had never actually attempted overthrow; he had merely paused to consider in the interstices of his life whether the Federation might be as benign an influence as it pretended to be and these pauses, it would seem, had been intense enough to attract the interest of the Surveyors.

In any case, it was too late for that kind of concern now. He had had a different kind of life on Mars and many associations which, if he had thought about them, he would have missed keenly, but his perspective narrowed, as perspectives on the Doom Planet tended to do, to his situation and he had decided that he would accept the conditions of his internment. He would create a universal solvent and find a container of some sort and he would present it to the Board and would be released. Once released he might carry the news of conditions far and wide to all the towns of Mars but then again he might not. It was impossible to project that far ahead. One thing he resolved was that he would have nothing to do with his roommates nor with any of his fellow felons. He considered himself to be several levels above them intellectually and he found their cynicism corrosive.

How Fritz was able to fulfill the conditions of his assignment and how he invented not only the universal solvent but a varying propane ring which enabled it to have other strange

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powers of alteration must fall without the proper scope of this history. As the various Acts & Regulations have established, the release of technological information is not only dangerous should it fall into the hands of enemies of the Federation, it is extemely boring to the majority of the populace who have no interest in the devices that manage their lives as long as these devices are workable. (Nor should they!) Sufficient to say that over a period of some time Fritz, relying heavily upon laboratory facilities and ignoring the jeers of his fellows was able to accomplish his task and under procedure applied for an appointment with the Board to whom he presented himself in due course. When his roommates heard through the usual network of inference that Fritz had actually scheduled an appearance before the Board their contempt and amusement was virtually unbounded but Fritz did not allow it to affect him. "You are a fool," the perpetual motion man, the harshest and most persistently abusive of his roommates said, "you are making a mockery of their very concept of punishment. The problems are insoluble by nature."

"Not with a universal solvent," Fritz said, permitting himself the most careful of private smiles.

"You will never be welcome in these walls again."

"That is of no concern," Fritz said. "After all, I will have obtained my release."

"A fool," the perpetual motion man said, "a fool," and stalked to the doorway, attempting a dramatic exit but forgetting in his choler that exitways were barred during this period and succeeding only in causing slight but painful damage to his nose. At this the antigravitation and disintegrator men roused themselves from their quarters to laugh almost as harshly as he but Fritz, all in all a kind and thoughtful man, had already detached himself from the conversation, preferring to think of his confrontation with the Board on the morrow.

It had long since occurred to him through his period of internment and researches, that the Federation was indeed a cruel and frozen regime engaging in repression at all levels of administration solely for the purpose of decadent self-perpetuation and that the Doom Planet was a fiendish means of not only interning dissidents but exploiting their very creativity but these insights were virtually incidental to the overall element of his growth which was that he had managed to solve one of the oldest of all scientific paradoxes. Besides this accomplishment the corruption of the Federation fell away, it was of no significance whatsoever. Of course the Federation was corrupt but then again, Fritz, not a particularly introspective man, had decided that almost all of history was a matter of corruption and that ultimately only individual ends, not collective destinies, suited. He therefore presented himself to the Board in a sanguine and optimistic manner and without questioning described what he had been able to accomplish.

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"That is remarkable," they said to him and indeed their expressions showed much approbation and astonishment, "but where is the solvent itself"

"I am carrying it with me."

"You are?" the Board said. There was a slight pause. "That is even more interesting. Where is the container?"

"Ah," Fritz said, "*I* am the container"

"Pardon?"

"*I* am the container," he pointed out "and the solvent reposes within me"

"But that is impossible."

"Certainly not."

"Of course it is," the Board said with more emotion than was its wont. "By definition you would have been dissolved. You could not be here, the solvent is a deadly poison—"

It occurred to Fritz that under pressure the Board lost its dignity which he could have anticipated anyway if he had given the matter some thought. There was his own loss of dignity to consider, the Board was, in its lovable way, no less human than he. There was a message there, the ultimate prevailing of humanity that was to say but he did not want to pursue the matter at this time. "But of course," he said gently, instead, "that is the point. I am in the process of being dissolved right now. There was a calculated Lag Effect."

Gently he extracted from his pockets schematics and diagrams to place before them in verification, gently he lay them in front of the gibbering old men and then as the solvent finally reached its critical point he consequently and with the most lingering of sighs, began to break down.

Ah, the breakdown! First the walls of molecules, then the outer edges of cells, the viscera themselves coming with relief askew the wall of self the personna and he became those mindless constituent atoms which under the influence of the amalgam . . .

. . . . Moved out.

Moved out to dissolve the floor, the walls, the Board itself to say nothing of the planet, consuming all of it utterly as the famous prophet had pointed out concerning another matter so that all that was left of the oppressive Federation in this difficult sector was a planet-sized glob of universal solvent, hanging there in space quite unapproachable (as one might suspect) by stabilizing forces and therefore a beacon to all who would in their own way seek to assert their individuality. A planet-sized signal of Revolution to absolutely clarify, a symbol of individual human will.

But, of this glimmer of triumph from the very jaws of defeat, of the fall of the Federation and of the heroic, brave and finally successful efforts of the Opposition (many of whom survived in the most cunning of ways) little enough need be said at this time, the tale being part of our great and arching folklore so we will merely pass now to our next exhibit which will depict in diorama to please all of you the history of the first and final Squaring of the Circle. ■

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It started one winter night when I couldn't find the screwdriver.

I told my roommate Cath, "I'm sure I left it on top of the refrigerator. I used it to put the light fixture back together, and then I laid it on top of the fridge while I made a snack. That wasn't more than three hours ago, and now it's gone."

"The roaches borrowed it," said Cath, who was washing the week's accumulation of dirty dishes. "You always say they'll walk off with the place someday."

"Be serious."

"Poltergeists, then."

I poked her shoulder. "Did you take it?"

"I was in the living room reading Freud. Do I need a screwdriver for that?"

"Well, what happened to it, then?"

"Honest to God, Jenny, I don't know. It'll turn up. What thief would climb three flights of stairs just to steal a lousy screwdriver?"

I wondered about that. For several minutes I'd felt that someone was standing behind me, watching me. Not Cath; someone else, someone I couldn't see. The suggestion of a burglar struck too close to my own suspicions. I resisted the impulse to peek into the broom closet, but I did check the back door; it was securely locked.

I shook off my uneasiness and returned to my room, determined to study through the rest of the evening. I'd been loafing a lot lately; with exams a week away, I played solitaire at my desk rather than review my chemistry notes. It helped dispel the tension. I sat down and picked up the deck. After half a dozen poor rounds, I promised myself I'd play only one more, and I dealt it out with vicious

lost and found

Sometimes opportunity doesn't knock—it sneaks around.

PHYLLIS EISENSTEIN

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Broeck Steadman

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slaps. When the game turned sour, I began cheating, but no matter what I did, I couldn't win. No wonder: pawing through the cards, I realized that the ace of spades and the ten of clubs were missing. I peered under the desk; there was the ten, but no ace. I checked the drawers, the bookcase, the floor beneath the bed, the dart board. Nowhere. I'd won a game earlier in the day—how could I have done that without the ace of spades?

If Cath was playing a joke on me, I'd wring it out of her.

She must have heard me step into the living room, for she looked up from her book. "Jenny, you look terrible. What's the matter? You *can't* be studying too hard."

"Did you take a card from my desk?"

"Card? What kind of card?"

"A playing card."

"Today?"

"A little while ago."

"I haven't been in your room today."

"The ace of spades is gone."

Cath shut her book and shook her head. "That's terribly symbolic," she said. With her green pen, she added small horns to the portrait of Freud gracing the dust jacket. "I'd say you were getting absentminded, Jenny." She meditated a moment. "Knowing you, of course, you couldn't have used it as a bookmark."

I sat on the arm of the chair. "Cath," I said very seriously, "have you ever thought you might be a kleptomaniac?"

She looked me in the eye. "No, but I guess *you* have. Couldn't you use your time a little more constructively?"

Growling under my breath, I took the hint and stalked back to my room. I sat down at my desk, put my feet up, and let my eyes and mind roam. Something was odd about the bookshelf in front of me. My University mug was gone. My quartz paperweight was gone. My leatherbound copy of *Othello* was gone. I turned in my chair and looked at the rest of the room, wondering where I could have put the stuff. Was I sleepwalking? My tennis racket was missing from its peg above the bed; the stack of records on the floor had shrunk by half. I looked into the wastebasket, wondering if I had unconsciously thrown anything there, but it was empty. That wasn't right: hadn't I thrown away some old English papers this afternoon?

Where *was* everything?

Again, the creepy feeling of being secretly observed stole over me. Someone was staring at my back, perhaps waiting for me to leave so he could come in and get more. More what? None of my stuff was particularly valuable.

I heard a muffled shuffling noise behind me. I turned and looked at the closet door. I didn't have the nerve to open it.

I shouted, "Cath!"

Suddenly I felt naked and weaponless. What if it *was* a burglar? He was trapped in there, probably desperate, maybe armed. Even though there were

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two of us, it might be wiser to call the cops and let them handle it.

Cath came in. "What do you want?"

"The closet," I whispered.

"What?"

"I think there's someone inside."

We stood there a moment. I could feel my guts twisting. The last thing on earth I wanted to do was open that door. I wanted to run out of the room, out of the apartment, as fast as I could.

Cath shrugged, stepped forward, turned the doorknob, and yanked the closet door open.

My heart, and everything under it, suddenly pressed at the top of my throat.

There was nothing in the closet but clothing.

I had a mild case of jitters for the next couple of minutes. Cath clucked her tongue, then led me to the kitchen and poured me a cup of tea.

"Take it easy, Jenny," she said, forcing me into a chair by the table. "You can't crack up till after exams are over."

"I—I thought . . . someone was in the closet," I gulped some tea; the cup clattered as I set it down in its saucer.

"We've been home all afternoon and evening. How could anyone have gotten in?"

I attempted a nonchalant shrug, but it turned into a shudder. "I don't know."

Cath pulled me into the living room after I finished my tea, and she handed me a paperback sex novel. "You sit in this nice soft chair and read something light, to relax. I'll sit over there and study."

I read, but I couldn't concentrate; I was too nervous to string the words and phrases together.

Then I heard something. A scuffling, rustling sound.

"Did you hear something?" I asked. "From my room?"

"Roaches," Cath said without looking up. "Or mice. Forget it."

I heard it again. "Cath!" I gasped hoarsely, springing across the room.

She caught my arm as I passed her. "Maybe we'd better go to a movie."

Then there was another noise, louder this time.

"I hear something in your room," she said.

"Roaches," I whispered.

"Okay, let's see what it is. Wait here a minute." She went to the kitchen and returned with two long, sharp carving knives. She gave one to me.

"What do you think it is?" I murmured.

"Some nut trying to get in a third floor window."

But when we stepped into my room, we saw that the window was closed and locked, as it had been for several months. Outside, silent snow fell vertically through the darkness; the thick, white frosting it had slathered on the window sill remained velvet-smooth, undisturbed. The closet door, however, was slightly ajar, although Cath had shut it firmly just a little while ago.

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"There can't be anyone in the closet," Cath said. "There simply can't be." Still, she went to the closet and threw open the door.

Someone was in the closet, all right. Two someones, both young and muscular, one male, one female. They were fair-haired and evenly-tanned, and they wore only scanty metallic briefs and weblike sandals. We stared; they stared back.

"Are you Jennifer Erica Templeton?" the man demanded of Cath.

"Not me," said Cath. "Her." The tip of her knife wavered in my direction.

"Jennifer Erica Templeton?" he asked me. "Born June 3, 1958 in Chicago, to Albert and Sara Templeton; student at the University of Chicago from 1977 to 1985, BA, MA, PhD Anthropology?" He rattled off the data as if it were name rank and serial number, and then he paused expectantly.

His friend nudged him. "I told you this was only '79, dear. She doesn't have any degrees yet, and her field is still chemistry."

I found myself nodding.

The man lunged, grabbing at my head. As I elbowed him in the solar plexus, I heard a snipping sound behind my right ear, and then he reeled away, clutching a handful of my hair. "Authentic souvenir!" he croaked.

"All right, all right," the woman said, hauling him back into the oddly deep space of the closet. "Now that you've got one, too, let's go home!" She slammed the door, and for several seconds a rummaging noise sounded beyond it. Then there was silence.

Cath stared at me, her mouth agape. She reached out and very slowly and gingerly pulled open the door. The strangers had vanished; once again, the closet was shallow and inhabited only by my clothes.

"Jenny," Cath whispered, "what's going on?"

I looked at her for a minute, and then I looked at the closet. I fingered my scalp where the spray of stubble interrupted the smooth flow of hair. "I'm not sure," I replied, "but tomorrow I think I'm going to transfer to the Anthropology Department." ■

in times to come

Since 1957, most of the world has recognized that we are solidly into the Space Age. Next year, we began the Second Era of that Age. The Space Shuttle begins its orbital tests.

One of the big differences that the Shuttle will make is to open up orbital operations for the "little guy": the university researcher or average-sized industrialist who has no experiment or piece of hardware that needs testing in orbit. No longer do you have to be big enough, rich enough, or important enough to have NASA devote a special launching just to you. In fact, NASA is willing to rent space on the Shuttle for quite a reasonable fee. Joe Haldeman heralds this new Era in an incisive nonfiction piece, "This Space for Rent," in next month's issue. The cover illustration will be by Robert McCall, whose Space Age murals grace the walls of the National Air and Space Museum.

Poul Anderson's "Hunter's Moon" will head the fiction in our November issue. Like the Pohl story in this issue, it's set on Medea (otherwise known as "Harlan's World"). We'll also have Orson Scott Card's latest story, and lots more! In November.

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the reference library

Thomas A. Easton

(Editor's Note: This special Reference Library column deals with David Rorvik's extraordinary book, In His Image: The Cloning of a Man *(Lippincott 1978). Lester del Rey's regular column will appear in next month's issue.)*

To clone a man—

First, be a multimillionaire with holdings in an underdeveloped Oriental country.

Second, fund a hospital in that country.

Third, tap an accomplished science writer to find someone able and willing to develop the techniques necessary to successful cloning and to apply these techniques to producing a clone of you, both in total secrecy.

Fourth, set the chosen biologist, codenamed "Darwin," up in your Oriental hospital with a few competent assistants and laboratories full of the latest medical equipment—microscopes, TV cameras, centrifuges, cryogenic cooling equipment, electron microscopes, X-ray and ultrasonic equipment, microsurgical manipulators, etc., etc.—and promise all the funding he needs and a grand cash payment if he succeeds.

Fifth, leave Darwin alone to get on with the work. Skipping all experimental work with animals in the name of expediency, he will begin immediately to collect hundreds of eggs from local women in the hospital for sterilization and other sex-organ-related treatments. He will learn how best to use fertility drugs to stimulate multiple ovulations, plucking the ripened eggs from the surface of the ovary with a needlelike suction device pushed through the lower abdominal wall and guided to the ovary with a fiber-optic viewing device. He will learn how to keep the eggs alive in culture baths, controlling their post-ovulatory maturation with biochemical treatments. He will learn how to remove their nuclei both mechanically, by cutting into them with microscopic scalpels and sucking the nuclei out through thin tubes, and with drugs that can force a cell to expel its nucleus. He will learn how to fertilize the eggs with sperm cells and how to keep the resulting embryos alive as they divide and grow from the 2-cell stage through the 4, 8, and 16-cell stages to

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the 32-cell stage. He will learn how to implant the 32-cell embryos in women so that they successfully embed in the uterine wall and the women become pregnant.

This much and more can be accomplished fairly easily. Each step has been reported from some laboratory in the U.S. or Europe, and all these steps are essential to any attempt to clone a human. They are, however, no more than a test-tube duplication of things that happen in the normal course of human reproduction. Cloning requires more.

The first work on cloning an animal was done in the late 1960s, when J. B. Gurdon of Oxford University chose to attack the problem with the African clawed frog (*Xenopus*). He began by destroying the nuclei of unfertilized frog eggs with ultraviolet light. He then transplanted into these eggs the nuclei of frog intestinal cells. One would not expect this step to be the equivalent of fertilization with sperm, for although body cell nuclei do contain all the genes necessary to specify a complete organism, most of them are "repressed," or inactive—only those genes needed to specify a particular cell's functions are not repressed, or active. The genes in eggs and sperm, on the other hand, are apparently not repressed, for they are all available to help shape the cells of the growing, developing embryo. Furthermore, there appear to be substances in the egg cell's cytoplasm (that part of the cell surrounding the nucleus) that can cancel out whatever influences repress genes in other cells. When an intestinal cell nucleus replaces an egg cell nucleus, the genes are therefore derepressed and the egg cell can divide and develop into a tadpole. Since the genes in the tadpole's cells are identical to those in the adult frog from which the intestinal cell was taken, the tadpole is called a "clone" (Greek for "twig," "slip," or "cutting," as well as "throng"). The tadpole and the frog are not, however, likely to be totally identical—they developed from different egg cells, and there are "cytoplasmic inheritance" factors in the egg cytoplasm that influence the growth of the embryo (in some snails, one such factor controls the direction of the twist in the snail's shell). That is, a clone will inherit some of its features from the source of the egg it grew from even though all its genes have a very different source.

Cloning mammals such as mice, cats, or humans is more difficult than cloning frogs. For one thing, the egg cells are many times smaller—pinprick size, compared to pea size. For another, the cells are much fussier in their environmental demands—they must be nurtured in special, warm, nutrient-laden solutions, not just dumped into a glass of water. Darwin's efforts will therefore focus for months on learning to keep alive and to manipulate human eggs and embryos. At the same time, he will be working on ways to replace an egg cell nucleus with a nucleus taken from one of the millionaire's body cells. The successful method will use a drug called cytochalasin

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B to force both body cells and egg cells to give up their nuclei. After exposure to an enzyme that strips off their outer layer, the egg cells will then be put in a nutrient medium containing a noninfectious virus known to induce cell fusion. When the body cell nuclei are added to this medium too, the virus will cause them to fuse with the nuclei-less egg cells. After treatment with various biochemical compounds, the "fertilized" eggs will begin to divide. When they reach the 32-cell stage, one of them will be implanted in an attractive, intelligent young woman chosen from the local population. This "surrogate mother," codenamed "Sparrow," did not donate the egg used to produce the clonal embryo, but she will nevertheless carry and nurture the embryo until delivery.

This is the tale David Rorvik tells as if it were true in his latest book, *In His Image: The Cloning of a Man* (Lippincott: 1978). The millionaire is "Max." The science writer is Rorvik. The science is legitimate and well told, although there are certain blank spots. The events of the book and the characters are supposedly thoroughly disguised in order to protect the anonymity of Max, the other participants, and Max's clone, a son, born in California two weeks before Christmas, 1976. Just how extensive this protection is can be best shown by quoting from the "Publisher's Note" that opens the book:

"In 1977 David Rorvik visited the J. B. Lippincott New York Trade Division offices and described the extraordinary events recounted in this book. He explained, however, that he had pledged not to reveal to anyone the identities of the other participants, which made it impossible for us to authenticate his story. We deliberated as to whether we should publish it under these circumstances. . . .

"The account that follows is an astonishing one. The author assures us it is true. We do not know. We believe simply that he has written a book which will stimulate interest and debate on issues of the utmost significance for our immediate future." (p. 5)

Only Rorvik knows the truth. But is he really letting us in on it? There could all too well be a "conspiracy of hype" between author and publisher, and this is what I suspect. Rorvik is known as a crusading but meticulous writer. As such, he has produced numerous articles and books on human biology and medicine and shown a particular concern with various themes of genetic engineering. It does not seem inconceivable to me that he chose to dramatize an account of the science that will surely someday make cloning possible by dressing it up as a true account for the sake of making the Literary Guild (*In His Image* will be an alternate selection) and selling paperback rights for a quarter of a million dollars. I may be wrong—Rorvik does say he expects the participants in the cloning project to reveal themselves eventually—but I don't think so. The science Rorvik cites in

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his description of how Max was cloned is entirely from the published scientific literature and is entirely science that will surely be essential to any eventual successful cloning. The holes in the science—vagueness in the specifications for nutrient solutions and for other steps in the process—cover information as vital as anything Rorvik chose to reveal. They must have been left because the scientific literature does not permit Rorvik to guess closely enough not to be proved wrong later. And the book itself, its plot, is a didactic ideal, exactly what would seem appropriate at this time in human history, when biology and medicine are daily offering up new tools for tinkering with the substance of life, for controlling fate. We have abortion and amniocentesis, we are about to get recombinant DNA (true genetic engineering) and cloning, test tube insemination and embryo transplants. And each offers its own ethical and moral problems, all of which deserve careful consideration.

In His Image is the tale of an aging bachelor, Max, who wishes both to provide himself with an heir as much as possible of his own blood and to give himself a chance to correct the results of a flawed childhood. He is vain and egotistical, powerful, a little corrupt, a perfect embodiment of the sorts of motivations that are likely to impel actual cloning. In this context, the previously published applications of cloning seem downright childish. Do we really need to perpetuate talent and genius beyond their normal span? Reproduce only the healthy? Provide large sets of genetically identical humans so scientific studies can unravel the effects of nature and nurture? Provide children of their own to infertile couples? Pander to the wish for children that are carbon copies of celebrities or dead loved ones? Provide sources for organ transplants?

The book's situation—journalist invited to organize a sub rosa and controversial project—permits Rorvik to explore the ethics of his supposed position, of cloning, and of human experimentation in general. That he spends almost half the book on such concerns may indicate the true nature of the book: Claim that a clone is born, and people will line up to buy the book. A writer's dream, and a guaranteed way to expose the average Jane and Joe to ethical questions so serious that they promise to affect everyone, not just the scientists whose work Congress threatens to stop or regulate. Researchers already have to obey rules that spell out how to treat animals humanely, to obtain the informed consent of human subjects, to minimize the danger of recombinant DNA "Andromeda strains." The ethical concerns that affect cloning research include the humane treatment of animals and informed consent, but they go further too:

—The research uses hundreds of human embryos, resulting from both natural (with sperm) and artificial (with body cell nuclei) fertilization, but only one or a few will ever be transferred to a woman's womb and

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allowed to mature; the rest, called "bench embryos," are flushed down the drain. Is this murder? Abortion? Or is it no more than cleaning out the test tubes? When is an embryo human? At fertilization? Implantation? Quickening? Birth? Or even later?

Some philosophers think every individual has an inalienable right to be unique, to have an unduplicated genotype; identical twins (and triplets, etc.) are the only natural exception. Is cloning therefore immoral for this reason?

Is human experimentation ever justified, even after experiments on animals have given the researcher reason to believe his or her human subjects will not be harmed?

Joshua Lederberg once described cloning as "a major evolutionary perturbation" (practiced on a large enough scale, it would freeze human evolution). Others have declared it an essential tool if humans are ever to control their own evolution. But do humans have the right to control their evolution?

Might the availability of cloning lead to new and terrible forms of tyranny, based on armies of identical ideal soldiers or on masses of identical ideally passive citizens?

And more. Rorvik discusses them all at length with a poignancy that can come only from a real or assumed personal involvement. He agonizes over each of them as he tries to balance responsibility and curiosity and worries what will happen to his reputation if things go wrong. The arguments sink thoroughly home, and in the process they produce a distinctly negative attitude toward the whole idea of cloning, particularly as it is put into practice in this book. Rorvik may have intended this effect, for he does seem to believe that cloning is a development that must be accepted cautiously and critically, if at all. It must not be rushed, as was nuclear power, so quickly that its more unfortunate side-effects emerge unforeseen. And he just may set people to thinking about bioethics enough to justify his book, fraud though it may seem.

Is *In His Image* a fraud, presented as it is? It is, if no Max exists and no cloning was actually done. But it is a useful fraud, a piece of "docu-drama" aimed at raising the public consciousness. And there are pointers in the text that suggest that this is how the book was intended:

—"The cloning of a man, because its impact would be so immediately dramatic, could make this new adventure [on the newly opening frontier of biological inner space] accessible to millions who might otherwise understand little of what was transpiring in the molecular world.

It was conceivable, then, that the cloning of a man might not inhibit but actually speed up the important research that was poised, like a rocket on a launching pad, ready to go forward." (p. 28)

—"Was I now going to try to laugh off what I had written, as if the world of books and articles were all make-believe?" (p. 30)

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—" 'Interpretative' journalism, it was believed by many—and their arguments were often persuasive—was needed to give the 'truth' three dimensions." (p. 74)

—"I entertain absolutely no expectation that anyone, scientist or layman, will accept this book as *proof* of the events described herein. I am fully cognizant of and fully respectful of the methods by which scientific data must be conveyed. I hope, however, that many readers will be persuaded of the possibility, even the probability, of what I have described and will benefit by this preview of an astonishing development whose time, at least in terms of some of the emotional and ethical issues it raises, has apparently not quite yet come." (pp. 207-208)

Rorvik is already well on his way to succeeding in his apparent aim. Every newspaper in the country has carried pieces on his book. I have even found a sports story, written by Dave Kindred and copyrighted by *The Washington Post,* about a race horse named Piece of Heaven and bred by the Florida Agriculture Experiment Station; Kindred writes "If a millionaire named Max can clone a descendant, why couldn't Secretariat?" and goes on, tongue in cheek, to give the details. And Barbara J. Culliton has written a piece for *Science,* the weekly journal of the American Association for the Advancement of Science, that recounts the controversy swirling about Rorvik's book even before its publication. The consensus of those scientists involved in work related to cloning, as she reports it, is that cloning will be possible before too many more years have passed, but it has certainly not yet been done. Not only could such a secret not be kept, but the state of the art is not yet fully enough developed to permit it. But not everyone is so sure Rorvik is lying. One group of scientists, together with the People's Business Commission (a public-interest lobby), has filed a Freedom of Information Act suit seeking information on all cloning-related work financed by NIH, NSF, CIA, and the Departments of Agriculture and Defense, with an eye on beginning public debate on the topic. In addition, the House health subcommittee is thinking of holding hearings on the topic.

Rorvik has been called a liar, a fraud, and a jackass in print, and his book has been called a hoax. But even though I do not believe his claims, I will not be that unkind. I suspect Rorvik of a devious, and perhaps mercenary, turn of mind, and I think he has devised a clever, attention-getting ploy that will have an entirely salutary effect. Bioethics *is* important at this time in our history, but like most ethical and philosophical areas, it requires too distasteful and laborious an amount of thought to get much shrift from the average Jane and Joe. Rorvik has put it into a frame as carefully and dramatically plotted as a novel. He has made it accessible, and he deserves far more praise than blame. *In His Image* is well worth reading, even if it should be taken with a grain of salt—or, better, two. ■

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Brass tacks

Dear Ben:

I can't resist replying to Donald Franson's letter ["Brass Tacks" April 1978], taking issue with the intrinsic usefulness of home computers. Let me make my position clear right from the start—even if I had nothing else to say (and I do, I do!), who gives a hoot-in-hell about *usefulness*? As I love to tell my students, when Faraday was asked about electricity, "What good is it?", his answer said it all—"What good is a new-born baby?"

I recommend that Mr. Franson (and all other Analog readers) take a look at an essay by Dr. John W. Mauchly (a man present at the creation of electronic computers in the early '40s) in the October 1977 issue of INTERFACE magazine. There, Mauchly points out that, today, hundreds of thousands of people (a lot of them are our brightest youngsters in elementary and high school) have more computing power at their fingertips, *at home*, than did Kepler or Newton (and, I might add, than did Maxwell or Einstein, too). I find that a very interesting thought, and no doubt it would make the basis for a good SF yarn. (I graciously give this idea away.)

I also go along with Mauchly's assertion that as the general public becomes more literate and skilled in computers, a broadbased appreciation and understanding of computer *simulation* will develop. In fact, I think this may well lead to imaginative, creative, radical attempts to study many important social problems (garbage collection routes in a city, for example) by people other than RAND Corporation scientists. As I think about it, *that's* a good story idea, too, and I toss it out to the world with my usual good-natured aplomb.

Now, let me give you my special, passionate, hoped-for impact of home computers. I start with one fundamental axiom: if a person can program a home computer to solve a reasonably challenging problem, within a certain time limit, then that person is reasonably intelligent, well-organized and logical. It is a well-known fact of experimental observation that the present members of the US Congress (with few exceptions) are lawyers. These people have spent long, arduous years in learning how to be obscure, illogical, and facile in the rapid production of mind numbing mumbo-jumbo incantations, best suited for

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accompanying the sacrifice of a virgin at Sunrise. *Sure* there are exceptions, but the odds are *you'll* never meet one!

In the computer society of the near future, it will be *expected* that an educated, intelligent person can program. I would like to see a constitutional requirement that all Federal office holders (elected *and* appointed) take a public problem solving test (carried out on public television, for example). How *about* that, *another* terrific story idea flipped out for someone!

In fact, as I think of the mess at the gubernatorial level in my own state (caused, in large part, by a sheer lack of gray matter), let's make public computer problem solving a requirement at the state and local levels, too.

Finally, I'll close with a parting shot at Mr. Franson's complaint that home computers are energy wasters. The KIM-I, for example, with audio tape cassette, uses just *seven* watts. Clearly, home computers are really energy *savers*. Because instead of watching the home color television set (using a heck of a lot more than seven watts as it rots their brains), your kids will leave it off and do something creative.

So I say to Mr. Franson—get with it, young fella, the wave of the future is passing over your head, and if you don't watch out, you'll drown in the backwash.

PAUL NAHIN

Excellent idea! But I wonder what would happen if the same test were applied to editors?

Dear Ben:

Donald Franson either knows nothing about microcomputers or suffers from a lack of imagination. He is wrong. There is almost no limit to what can be done with LSI technology, and most of those will be eliminated when the next generation (32-64 bit words, and incredible cycle times, they say) becomes feasible. *Time* did a cover story on home computers, and the line that struck me was "A Cray-1 in your hand in 1985." That is *amazing*. Today, 1978, the Cray is the best computer you can't afford, @ $9,000,000+. They use it for long-range weather forecasting. The article also describes Shalmaneser (without the intelligence, I assume).

As far as what can be done with the S-100 bus systems sold today (for $1000-$3000), let me list a few:

- Your book system. The rip-offs caused by cheaper copies would be more than offset by no more Returns alone. Not to mention no more paper costs, or printing costs.
- No more Post Office.
- *Secure* electronic banking, mail, voice and other types of transmission of information. Video might be a little rough till the 80s. See *Scientific American,* Aug. '77., *Mathematical Games,* for a description of trap-door/public-key codes.
- A three-dimensional plotting device. With a little more memory, a three-dimensional anything device.
- A text-editing typewriter, and you can make any key mean anything.
- Reusable "paper."
- A cheap copying device. This will cause problems, but anything your computer can read it can copy.
- A home-controller. No more wasting energy without knowing it.

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Much more energy would be saved than the machine would use (50-200 watts and no fan).

- A cheap security device, answering to voice prints and/or code words, that can call anybody faster than preventive action can be taken. There is a town in Texas that hasn't had a property crime in years due to a similar device, and it just has three buttons (fire, police, hospital) and alarm circuitry. A home-owner could pay back his computer investment in his savings from his reduced fire/theft insurance.
- Telephone buffer.
- Remotely activated emergency warning device.
- An educational tool. Suppose Einstein had had a computer that made space-time visual, and could show real-time interactions therein.
- A shopping aid. Stores could categorize their inventory and put it on the public net (along with their prices). Let your fingers do the driving, and save gas, too.

I can go on.

Today's microcomputer could do all of these things, with peripherals and programs. And one more thing. A net. The problem lies not in that there is no way to do it, but rather in that there are not enough people who already have computers to make interconnection profitable. I imagine that the telephone had the same problems. The computer to do all these wonderful things for you is there today, and getting better and cheaper daily. I should send you my $395 HP-35, that I bought in 1972.

Mr. Franson is also wrong when he says "The home computer is the *model railroad* of the future." It is rather the model *automobile* of the future, at least as far as social impact is concerned. The impact of the personal computer may be as great as the personal car. Who could see much future in the car in 1900 when there weren't many paved roads, or gas stations, for that matter.

Of course, anything that a computer does must be programmed. Exactly. Special-purpose programs cost money. Once, and for one person/group. But if you could sell 10,000 copies of something that took a year to write at a dollar or two a throw . . .

But I guess Mr. Franson is right and there is no future for the personal computer, so I'll just play with my hobby (and maybe look for a publisher in a few years).

KEVIN MURPHY

231 W. Tujunga
Burbank, CA 91502

And what about implanted microcomputers with direct access to the individual's nervous system?

Dear Ben:

I too *was* skeptical (re:Franson, Brass Tacks, April '78) about home computers, they seemed only useful for game playing and as a challenge for equipment building electronics buffs. Game playing using a TV and other complex electronic equipment doesn't make good economic sense to me and if you are going to build complex and expensive electronic equipment, as a challenge, it should also have a practical and a useful application. The question I was asking was what are microcomputers good for that you can't do in other ways at a lower cost? No one I asked the question of could give me an answer that

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was satisfactory. Then I read Martin Buchanan's article "Home Computers Now!", in the November 1977 issue of Analog. This opened a few doors and windows for me, and got me going. I followed up some of his references and visited three computer stores here in Toronto and purchased a number of periodicals and books about microcomputers.

I was very much intrigued by Buchanan's description of word processing via the computer and this seems to be a very desirable application that can't be accomplished by other means, except by laboriously writing and rewriting, either by typewriter or by long hand. I do all my letters, articles and essays by long hand, then I type them after I have them the way I want them and this letter is no exception.

So word processing would be my number one application for a home computer, although this may not be something that most householders would want in a personal computer. The mere fact that you can record the results on tape or disc for future use is also very appealing, particularly for articles, essays, and, of course, for stories. It would not surprise me in the least, if it hasn't already been done, that circuitry and programming can be provided so that certain words that are often misspelt mechanically will be done correctly. . . . like the word receive, where you get the "*i*" before the "*e*." There is also the possibility of a punctuation program. That might be a boon or otherwise for a budding author.

Ben, besides your suggestion for books and magazines, I think that all first class mail will be sent by computer in the future, this means all private correspondence, business mail, such invoices, etc. For privacy sake between individuals there will be scrambler devices available. Hopefully, this will be accomplished by private enterprise and not the usual government bureaucracy. . . .

An application that I find very intriguing is a conference discussion by computer. . . .

Also, of course, it will be used for applications which some of us may not take to very well. This is not necessarily a home computer application, but it will use similar equipment and programs. As a matter of fact, there was advertisement in our local morning paper for such a gadget. It's called a computer dialer, which will dial 1000 telephones and deliver a commercial message and record responses to same and all this without any person controlling, except to turn it on and off, after, of course, supplying the necessary numbers. The price is $6900.00 (Can.). An electronic alternate to junk mail. Of course, if you get a call of this type you can just hang up the phone, as I usually do for calls of this type.

JOHN MILLARD
18-86 Broadway Avenue
Toronto, Canada
M4P 1T4

Home computers are with us, for better or for worse!

Dear Mr. Bova:

In terms of energy wasted and redundancy, I find no evidence to condemn home computers. In those terms, we all need to live in one or two bedroom apartments and drive Mopeds. It just so happens that my wife and I live in a one bedroom apartment and drive a Volkswagen . . . we

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make do by efficiently utilizing space and suppressing the urge to drive 100 miles per hour. We have found that the use of an Apple II computer in the apartment increases our electric bill from $15.00 to about $16.50 per month. That $16.50 is the total bill, not what it costs to run the computer! So much for the waste of energy.

As for redundancy . . . the uses of a home computer are *not* restricted to ping-pong and Star Trek! The Star Trek game is fun and I like to figure the stats for L-5 etc. but these are certainly not all the computer is good for. If this is all a home computer means to you then you don't need one. I don't need or want a big Ford station wagon but I don't say that they are useless a large family might actually *need* one.

The uses of the home computer can be tailored to one's specific needs and include budgeting, energy use monitoring, household finances, and record keeping of all types. These uses are just the ordinary . . . the computer's *out-of-the-ordinary* uses are what makes it special.

If a person has everything to make his life complete, then there is no need for the home computer . . . but . . . some of us are not so fortunate.

The *not-so-fortunate* people that I refer to are the elderly, handicapped and infirm. With the aid of the home computer these people can have access to activities that have heretofore been denied them. These uses can include but are not restricted to:

1. Monitor vital signs and warn of difficulties. It can keep track of medications and remind you when they are needed.

2. With video and remote control interfacing, an incapacitated person can clean the house, fix dinner, get the mail, answer the phone, type this letter, etc.

True, the computer can be programmed to provide for these functions, but, it has been my experience that the handicapped want to do for themselves, not have everything done for them. The computer with peripheral equipment would be programmed to make it possible for the invalid to do for himself. The controls can be interfaced with the individual so that if hands and fingers are not available, then toes, chin and tongue, or voice activation can be utilized.

3. With the aid of a speech synthizer, a mute person can answer his own phone and carry on a nonrecorded conversation by watching his TV and responding phonetically with the terminal keyboard.

4. Monitor energy usage in the house or apartment and make the necessary adjustments without the incapacitated person having to physically be present.

5. Serve the purpose of home entertainment center for a bedridden person that wants more than Monoply or checkers. Monoply and checkers are rather limited creatively and also require an opponent. Opponents are supplied by human visitation and unfortunately, invalids never have enough companionship. No one has time to spend seeing to the needs of a lonely invalid. The computer will let loose an imprisoned creative mind especially if that mind has lost its manipulative vehicle for self-expression.

6. The computer can be used to communicate with another computer

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over telephone hookup with the idea of supplying human opposition for recreation or just to exchange information from programs to recipes for clam dip.

All of these suggestions can be realized now with what's available from the hobby computer store. The equipment currently costs (for the above mentioned) about what a medium priced car costs . . . that seems high but the prices are coming down and we also tend to overlook cost when we want something badly enough. Besides, since everyone seems to feel that they need a car and they are expensive . . . the handicapped person may also want a car for the freedom that he thinks it will give him . . . he's likely to find that he is blocked by steps, curbs, doorsills, and steep slopes when he leaves his car.

It is my hope that the home computer will prove to be a Godsend for those less fortunate. It can be used to help break down barriers in the home and give a chance to those who want to live in a less restricted world . . . much like a person with no legs getting a new lease on life when he goes into space where he weighs nothing!

The computer system is affordable and likely to become even more so in the near future . . . the cost to run it is well within reason now . . . much less than the extra rooms in our houses that we don't use and that over-powered beast parked out front . . . not to mention the color TV-stereo console!

Computers are just gizmos by themselves . . . their use is limited only by the limits of the mind of the user.

GENE A. DEES
2101-C Sutton Drive
Raleigh, NC 27605

. . . *Er, there are some* financial *limits, too, aren't there?*

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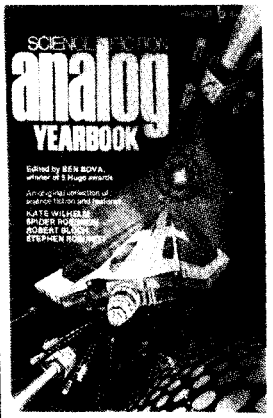

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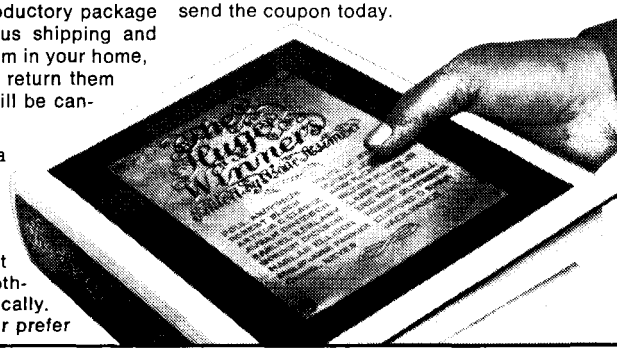

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